MACHINERY

February, 1909.

AXLE TURNING—METHODS AND PRODUCTION.

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THERE has always been an unsatisfied feeling in the mind of the writer because of the fact that the power, strength and rigidity of machine tools are so seldom taxed to the extent that the designer provides for, and because the actual output from machines falls so far below an estimated output, based on the cuts and feeds that the machines were capable of carrying.

Any knowledge or understanding of the forces tending to restrict production should be of value to the designer and to the owners of machine tools, and articles treating of the operation of machine tools under actual shop conditions and not with the bright side always showing, should make towards progress in the world of designing. It is this belief that prompts the writer to offer the following observations:

During a recent period of the writer's experience, it involved upon him to make a study of axle turning in a number of shops in the Middle West from which came reports showing an increased production from the machines. After sifting the many notes made during these visits, the methods in vogue in three of the shops were taken as a basis for the forming of a routine of operations that would conserve the time and efforts of the operator and work the machines up to their power and strength. Naturally, some changes in design resulted from this study of machines in operation—not under rosy conditions, but in the cold, hard realm of actual practice where conditions of lighting, heating, power and conveniences for the men were more adverse than favorable.

The following conditions tend towards a large output from axle lathes, especially from the double axle lathe with center drive:

Machine.—A minimum of obstacles to getting the work in and out; quick-setting driving dogs; quick and easy means of changing speeds and feeds; positive feed stops; a surplus of power.

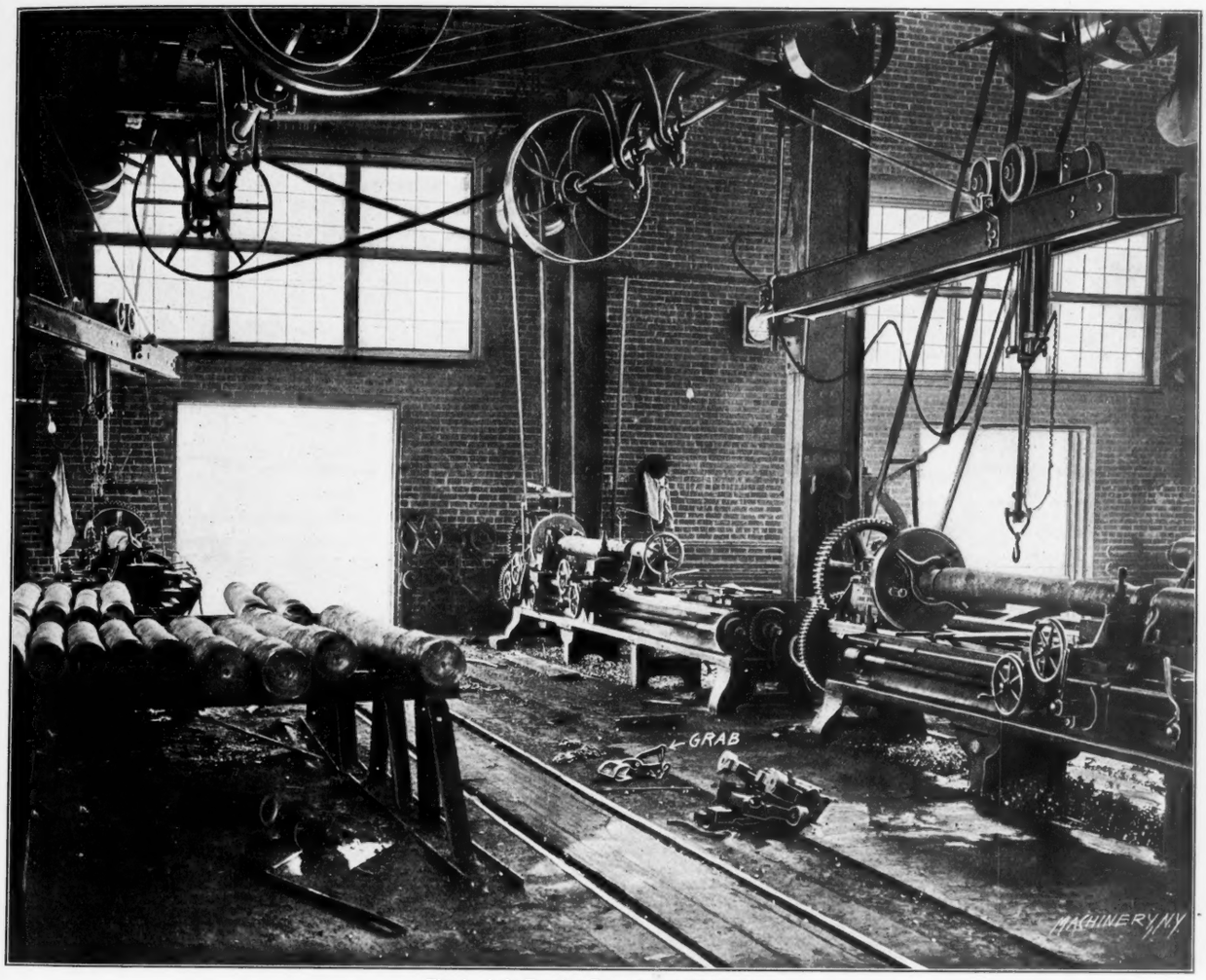

Fig. 1. Axle Turning Department, Shop No. 1.

Machine Auxiliaries—Tools and Gages.—Quick-acting hoists with fairly sensitive control; an abundance of cooling fluid for the tools; tools of efficient cutting angles; duplicate sets of tools for each machine; tools ground in tool-room to approved shapes; tools tempered properly; fixed points on machine for setting tools; limit gages for diameters; length and shoulder gages.

Shop Conditions.—Good light and good ventilation; plenty of work ahead of the machines; axles taken to the wheel press immediately.

Workmen.—A stable piece-work rate, or preferably some form of premium plan.

In order that the reader may make his own deductions and

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perhaps work out a routine better than will be given later, the notes will be presented in much the same order in which they were gathered.

The axle turning in shop No. 1, of which the axle department is shown in Fig. 1, seldom went farther than the roughing operation, the axles being forged at this plant, roughed to within ⅛ inch of the finished size and sold to car shops and railroad shops. This phase of the commercial production of axles is presented in connection with the methods of a car-building plant and a railroad shop in order to cover the subject fully. Many of the axles were of the P. R. R. 100,000-pound car type of steel. (See Fig. 2.) These differ from the M. C. B. standards in having the tapering center portion rough turned. This is the explanation of the use of the single axle lathe, which permits of the use of a taper attachment. The rest of the axles were of the M. C. B. 60,000-, 80,000-, or 100,000-pound type, or locomotive driver axles of 7-, 8-, 11-, 12-, or 14-inch diameters. On a single axle lathe, the carriages both feed in one direction and because of this, car axles have to be reversed when being turned. Axle lathes built by the Niles Tool Works of the Niles-Bement-Pond Co. are used exclusively in the shops where the notes were compiled, and are considered to fulfill the demands of the varied conditions successfully.

Methods in Shop No. 1.

The axles are picked up, from the horse at the left in Fig. 1 by means of the grab shown on the floor in the center of the space near the track, and swung around onto the lathe centers, white lead being used as a lubricant for the centers.

Tools.—The tools used were of high-duty steel, of course, 1 x 2-inch stock, ground as per Fig. 3, the radius *a* being the same as the large fillet of the journal bearing next the "leather bearing" (Fig. 5), and the radius *b* being the same as the small fillet next the collar.

The feed used was generally 1/16 inch per revolution and the average speed of cutting was 45 feet per minute; the tools stood up to this duty for five and six axles.

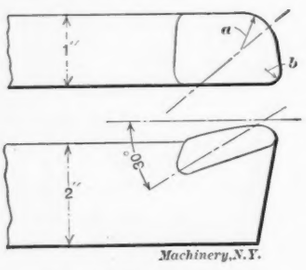


Fig. 3. Lathe Tool used in No. 1 Shop.

The consecutive tool movements are designated as "cut No. 1," etc. (See Figs. 4 and 5.) The tool setting for cut No. 1 was obtained from the machined collar diameter of the previous axle before removing the same from the lathe. The operator stands by the tool for the twelve or more revolutions necessary for this cut, and then feeds the tool in with the cross-slide (calipering for the journal diameter) on cut No. 2, then throws in the power feed for cut No. 3. His next move is to start cut No. 4 with the left-hand tool (an over-run on this cut can do no harm) and he has ample time to return to the right-hand end, throw out the power feed, and feed by hand to finish the journal length to gage. The tool is then set to turn the collar, after which the carriage is run as far towards the tailstock as possible, preparatory to turning the axle end-for-end in the machine. Cut No. 4 is finished by this time, and the axle is then reversed.

Cut No. 5, Fig. 5, is then started and then No. 6. Cut No. 5 is completed by the time No. 6 is started, so No. 7 and No. 8 follow, duplicating No. 2 and No. 3 on the other end. The operator now has two long cuts going at the same time and gets a breathing spell. When cut No. 6 is finished, cut No. 9 is started; then cut No. 10 follows No. 8, the operator staying

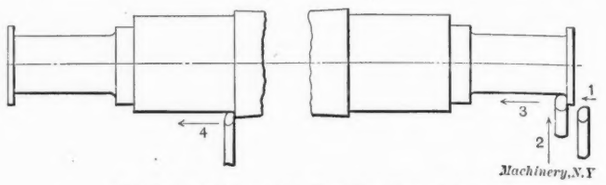


Fig. 4. Cuts taken with First Position of Axle.

with No. 10 until the correct length of the leather seat (some times called "leather bearing" or "dust-guard bearing") is obtained, allowing the tool on cut No. 9 to over-run and "cut wind." After throwing out the feed on cut No. 9, the right-hand tool is set to the collar diameter ready for the next axle.

Turning Pennsylvania Railroad 100,000-pound Car Axles.

The routine for turning the axles shown in Fig. 2 is simpler than for the M. C. B. type, as the lathes are designed with this particular work in view. Cuts Nos. 1, 2 and 3 are started in succession, and when cut No. 3 is well under way, cut No. 4 is started, using the forming slide (similar to the familiar taper attachment slide on engine lathes). Cuts Nos. 5 and 6 are taken consecutively and the axle is reversed when these cuts are completed.

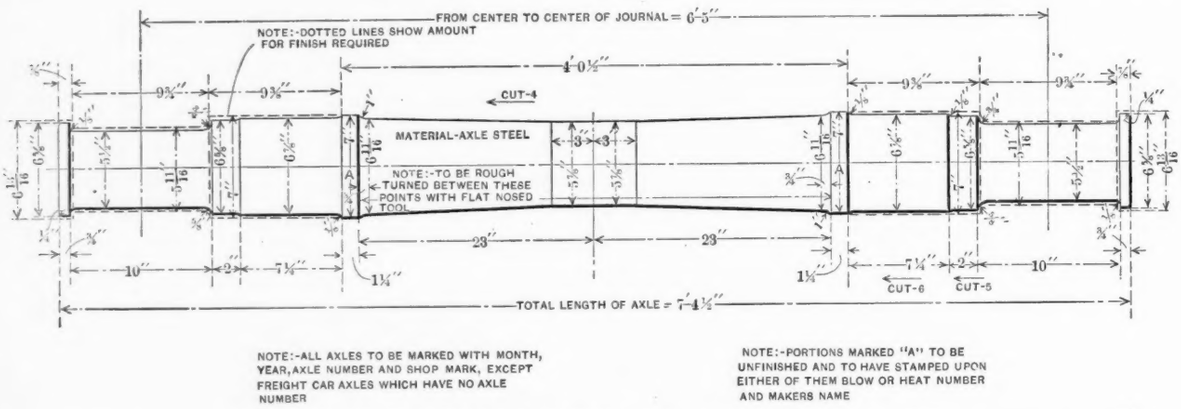

FROM CENTER TO CENTER OF JOURNAL = 6'-5"
NOTE:-DOTTED LINES SHOW AMOUNT FOR FINISH REQUIRED
4'-0½"
CUT-4
MATERIAL-AXLE STEEL
NOTE:-TO BE ROUGH TURNED BETWEEN THESE POINTS WITH FLAT NOSED TOOL
23"
23"
10"
2"
7¼"
1¼"
CUT-6
CUT-5
TOTAL LENGTH OF AXLE = 7'-4½"
NOTE:-ALL AXLES TO BE MARKED WITH MONTH, YEAR, AXLE NUMBER AND SHOP MARK, EXCEPT FREIGHT CAR AXLES WHICH HAVE NO AXLE NUMBER
NOTE:-PORTIONS MARKED "A" TO BE UNFINISHED AND TO HAVE STAMPED UPON EITHER OF THEM BLOW OR HEAT NUMBER AND MAKERS NAME

Fig. 2. Pennsylvania Railroad Co.'s 100,000-pound Car Axle, Journal 5 1-2 x 10 inches.

Production in Shop No. 1.

The output from axle lathes in most shops is governed by the maximum average daily wage that the workmen believe will be permitted without bringing about reductions in the piece-work prices. This proposition holds true in this instance, as may be seen in the following figures; the number of axles per day times the piece price approximates $2.50 per day (the prevailing rate in shops in the immediate vicinity). The time taken to rough finish a 60,000-pound car axle, to within ⅛ inch of the finished size, was 20 to 22 minutes.

Kind and Size.	Number per Day.	Price Paid.
P. R. R. 100,000-lb., turned all over	9 to 10	25 cents.
M. C. B. 100,000-lb	18 to 20	14 cents.
M. C. B. 80,000-lb	22 to 24	
M. C. B. 60,000-lb	25 to 28	10 cents.
Driver Axles.		
14-inch	5	50 cents.
11–12-inch	6 to 7	40 cents.
7–8-inch	9 to 10	25 cents.

NOTE.—The M. C. B. 100,000-pound axles were of very hard and tough steel, and would sometimes require two cuts although they were forged closer than the smaller axles.

Turning 60,000- and 80,000-pound Car Axles at Shop No. 2.

Axles at the car shop No. 2 were turned on a smaller Niles lathe designed for street-car axles, but still the output and quality compared favorably with the work done on the heavy machines at the railroad shop No. 3. The methods in vogue at shop No. 2 were very interesting, particularly because the operator handled his work unassisted, while the workmen in shop No. 3 would often get help from the laborers when putting the axles into the lathe. At shop No. 2 the axles were brought into the shop on high two-wheeled trucks, carrying two or three axles at a time, and rolled onto horses set at the height of the lathe centers. The arrangement of the machines and trestles is shown in the plan Fig. 6. Axles were picked up and swung into the lathe by means of the lever hoist (Fig. 7) arranged to traverse on the arm of a jib-crane of about 10-foot radius. It will be noticed that the work is put in the machine from the front side contrary to the usual prac-

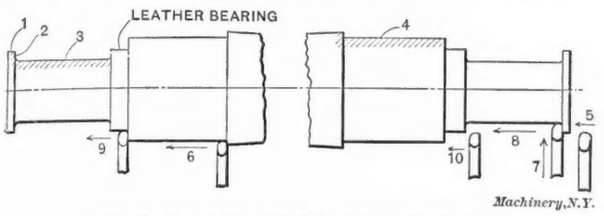


Fig. 5. Cuts taken with Axle Reversed in Lathe.

tice where the crane is attached to the back of the lathe. When the axle was through the center head it was let down, or rather dropped unceremoniously onto the tool carriages.

The left-hand end was raised to its center by means of a small lever, and the right-hand end to its center with the hoist.

Tools.—The tools used were similar to those in use in the railroad shop (see Fig. 11). The cutting angles were 27 degrees for roughing and 20 degrees for finishing. While the axles were on the horses, they were gaged for total length as sometimes the over-length would amount to ½ inch. This extra length was left on the collars, making the distance from shoulder to shoulder the same on all axles. This distance being uniform, the wheels were easily and quickly pressed on to the proper point in relation to the journals, these shoulders serving as reference points for gaging the wheel-pressing.

Feeds.—Feeds of 1/16 inch or 1/12 inch were used for roughing and 1/8 inch for finishing. Following is the order and character of the cuts:

Cut No. 1, *Fig.* 8.—The collar is roughed with right-hand tool. This tool feeds about 2 inches before the operator can

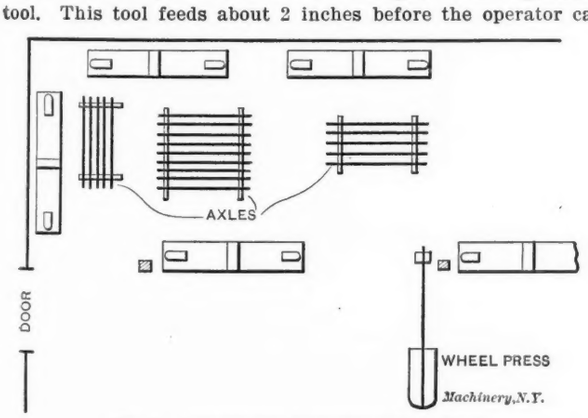


Fig. 6. Arrangement of Machines, Shop No. 2.

return from starting the left-hand tool on the duplicate cut on the other collar. Note.—All right-hand cuts are duplicated on the left-hand end.

Cut No. 2, *Fig.* 8.—The tool is forced into the axle cutting down inside of collar, making allowance for over-length, deep enough to get under the scale where there is the least stock; then the power feed is thrown in.

Cut No. 3, *Fig.* 8.—The right-hand tool is fed by power until the journal length is obtained, using gage as shown.

Cut No. 4, *Fig.* 8.—The right-hand tool makes second cut on journal. The tool is fed in to within 1/32 inch of finished diameter and power feed thrown in.

Cut No. 5, *Fig.* 8.—Roughing cut on leather seat, to gage.

Cut No. 6, *Fig.* 8.—Only cut on wheel fit, fine feed, to gage.

Cut No. 7, *Fig.* 8.—Outer edge of collar is chamfered.

Cut No. 8, *Fig.* 8.—Operator puts in finishing tool and finishes cut on collar.

Cut No. 9, *Fig.* 8.—Cutting down inside of collar, finishes the fillet.

Cut No. 10, *Fig.* 8.—Finishing cut on journal, using the other edge of the gage for the fillets.

Cut No. 11, *Fig.* 8.—Operator slightly tapers the wheel fit for about ½ inch to facilitate entrance into the hub of the wheel when pressing on.

Burnishing, Fig. 9.—The finishing tool is taken out and the burnishing roller is put in. This roller is of hardened steel, smoothly polished, and is forced against the axle sufficiently to roll down the high tool marks, leaving a smooth glazed surface. The feed is about ⅛ inch per revolution.

The rolling tools are then taken out and the left-hand roughing tool is set from the collar, ready for the next axle.

Limits.—The axles are turned to within 1/32 inch of the diameter on the journal and to within 0.01 inch of the diameter on the wheel fit. These limits may not seem very rigid for a turning operation, but the workmen consider them so. That they are close enough is self-evident from the number of wheels and axles in use and the uniformity in the reading of the pressure gage when the wheels are being pressed on.

Production.—The above routine of operations enables a 60,000-pound car axle to be put into the lathe, roughed, finished and burnished, and taken out in 45 minutes. This time

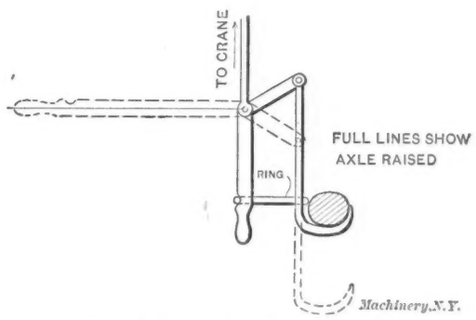


Fig. 7. Lever Hoist for Axle Lathe.

was made on very tough, hard Carnegie steel. The time on 80,000-pound axles was 60 minutes.

Notes from the Railroad Wheel Shop No. 3.

The first impression was that of the cramped quarters and the poor arrangement of the lathes, car-wheel borers and the wheel-press relative to one another. Then the power was at all times deficient and sometimes almost nil, as the line-shafts were driven by a vertical slide-valve engine whose source of steam supply was at a remote point and inadequate. This condition of the power affected the time per axle greatly, as the operators could seldom carry the amount of feed they wanted, because the amount of stock on the journals varied from ¼ inch to ¾ inch. The axles are centered from the wheel-fit.

The foreman of the wheel shop was a broad and considerate man and well liked by the workmen. This feeling of good will had a great deal to do with keeping the average output up to a mark well above the average in the majority of wheel shops of other roads.

The routine of operations will be taken up briefly, as it followed that of shop No. 2 excepting the order in which some of the cuts were taken and the type of gage used.

Tools.—The roughing and finishing tools were similar to those used in shop No. 2 as shown in Fig. 11. Fig. 10 shows the gage used, no attention being paid to the variation in the length of the axles.

Speeds.—The speeds of cutting averaged 45 feet on the wheel-fit and 35 feet on the journal bearing; the belt remaining on one step of the cone for all cuts. The Niles lathe since has been changed so that a speed correct for the various diameters can be obtained without loss of time. The power required for axle turning justifies a large motor to each tool,

and the ease of making speed changes would naturally bring about an increased output were the wages of the workmen increased by a fair premium plan.

Feeds.—A feed of 1/12 inch was generally used for roughing, and 1/8 inch for finishing. A coarser feed would have been used for finishing but for the difficulty of grinding a sufficient length of straight edge on the tool. This objection would not have held if the tools had been ground to shape in the tool-room.

Routine.—In the following description, the right-hand cuts only will be mentioned. The left-hand cuts follow each right-hand cut in turn. The first roughing cut is taken on the collar and as the leather seat is the same diameter, the operator then moves the tool over and starts this cut, avoiding the calipering necessary in the routine of shop No. 2. The third cut roughs the wheel-fit.

The fourth cut finishes the wheel-fit, the tool not being changed but simply knocked around to present a scraping edge

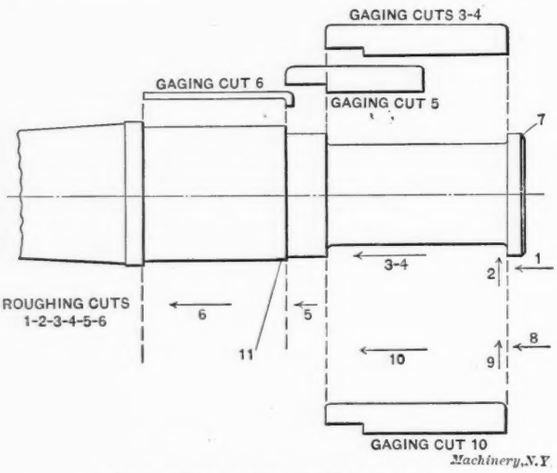


Fig. 8. Order of Axle Cuts in Shop No. 2.

to the work, and the feed changed to 1/8 inch. The journal is then roughed with a 1/12-inch feed. For the sixth or finishing cut on the journal the operator changes to the finishing tool and 1/8-inch feed. This cut removes about 1/64 inch on a side. The seventh and eighth cuts finish the collar and the leather seat. The collar edges are then chamfered. The rolling operation would naturally follow without removing the axle from the machine, but at the time of the writer's visit the journals were burnished in another lathe involving a second handling and taking about ten minutes time of another man's time, besides the time of handling. Since then, however, the burnishing has been done in the same lathe and less than five minutes is added to the time of roughing and finishing. The burnishing roller, shown in Fig. 9, is about 4 inches diameter and of 1⅛ inch face. This roller must be

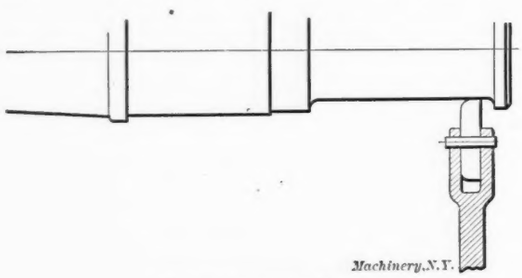


Fig. 9. Burnishing Tool.

very hard, yet not allowed to go out of round in hardening, and must be polished like a mirror, if true, round journals would be obtained.

Production in Shop No. 3.

To get a line on the production of the lathes was somewhat difficult, as steel, and wrought iron axles were turned in the same lots. Some iron axles were much more difficult to turn than those of steel on account of seams, though the output of iron axles was somewhat greater. Often iron axles would be three-fourths finished and counted as finished, when they were thrown out as defective; also the effective speed was greater on iron axles. The belt was on the same step of the cone for iron axles as for steel, but the resistance to cutting was less and the speed of the line shaft would not drop so much when all the lathes had heavy cuts going at the same time. The foreman of the shop gave the output that could be ob-

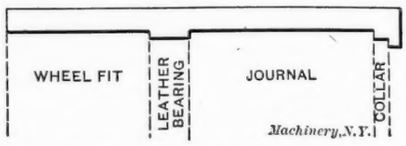


Fig. 10. Gage used in Shop No. 3.

tained by crowding, if the workmen felt sure that the piece price would not be cut, as follows:

Axle.	Daily Average.	Maximum per Day.	Piece-price.
60,000-lb.—			
Iron	20	24	20 cents.
Steel	16	20	25 cents.
80,000-lb.—			
Iron	16	20	25 cents.
Steel	14	18	35 cents.

These figures were for the roughing and finishing operations. The figures on record from one lathe for a month's run on 80,000-pound axles, more than half of which were of

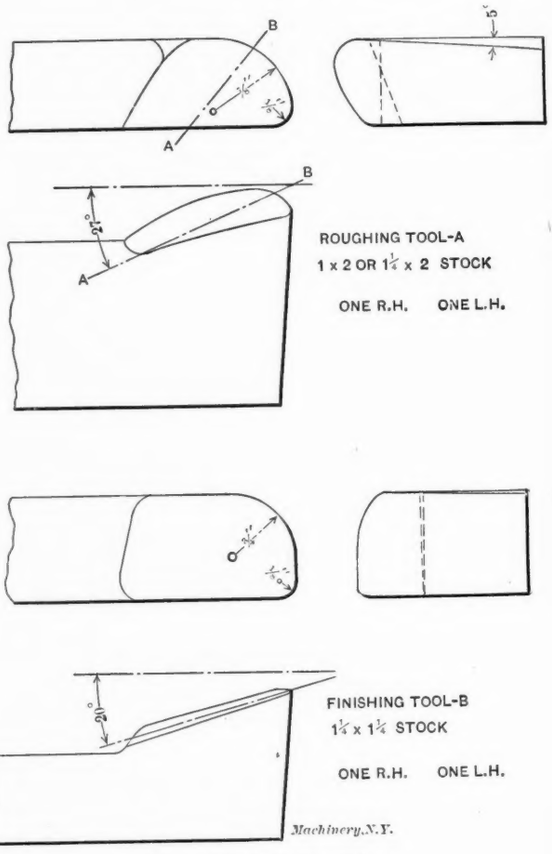


Fig. 11. Tool Shapes A and B.

steel, were for 24 ten-hour days—a total of 315, or a daily average of 13. The maximum per day for steel, was 14 and for iron, 18. On one day (writer's observation) on 60,000-pound axles, the first lathe turned 17; the second, 18, and the third, 19, in a ten-hour run.

The time per axle in shops No. 2 and No. 3 is shown comparatively by the following:

	Shop No. 2.	Shop No. 3.
Steel, 60,000-lb.	45 minutes.	32 minutes.
Steel, 80,000-lb.	60 minutes.	48 minutes.

The difference was in a measure due to the less rigid inspection in the railroad shop No. 3 and to a higher wage rate per day.

Recommended Routine.

From the study of the methods of the three shops the following routine was evolved, which has been proven out a number of times, to the writer's knowledge, by a demonstrator. The favoring conditions as presented at the beginning of this paper, should rule if the time is to be approached. This routine is for a double axle lathe and the right-hand cuts described should be duplicated at once with the left-hand tool unless otherwise noted.

Fig. 14 shows a standard M. C. B. axle with a 5 x 9-inch journal with the finished sizes and maximum amount of stock allowed on the different diameters.

Tools.—The tools must be of high duty steel and forged and treated to get a maximum of endurance. The shapes and

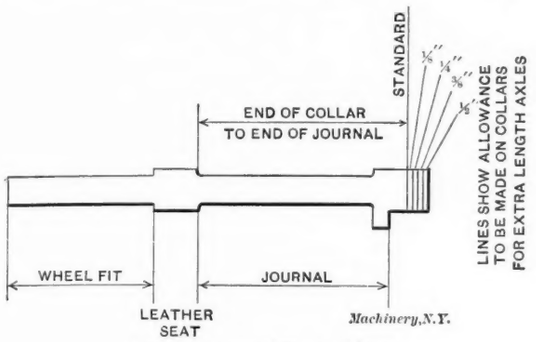


Fig. 12. Approved Form of Gage.

angles shown in Fig. 11 are recommended as being durable and economical in the power consumption.

Speeds.—With the above tools and sufficient power, a cutting speed of 45 to 60 feet per minute can be maintained and the tools will not require grinding oftener than every fifth or sixth axle.

Feeds.—When there is less than 3/8-inch stock on a side, 1/8-inch feed can be carried easily; when more than 3/8 inch of stock on a side, use 1/12-inch feed.

Gages.—An over-all length gage should be provided. This can be of 1/4-inch square steel rod, one end formed with a hook and the other end marked with lines showing the standard length and the surplus lengths by 1/8 inch up to 1/2 inch.

A gage to be used on the lathe is shown in Fig. 12. This gage combines the features of the gages used in shops No. 2 and No. 3.

The axles should be brought into the shop and placed on horses at a height 3 or 4 inches lower than the lathe centers.

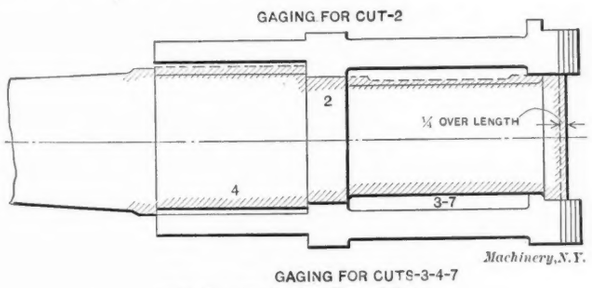


Fig. 13. Illustrating Use of Gage.

The center holes should be lubricated with white lead or heavy grease. Axles should be gaged for length noting the over-length. The form of scissors grab used in shop No. 1 is recommended, as the axle cannot slip but nevertheless it can be released instantly. The driver-dog should be hanging on the nose of the right-hand tailstock ready to slip on the axle when in place. The axles should be gripped at about the same place every time so that they can be placed on centers easily. The hoist can then be swung back out of the way and be ready to take the axle out of the machine without searching for the point at which the axle balances.

Cuts.—As this routine contemplates entering the axles from the rear, the setting for the roughing tool for the first cut on the collar can be obtained by placing a piece of cardboard between the tool and the finished collar before removing an axle from the lathe. For references, see Figs. 13 and 14.

Cut No. 1.—Right-hand collar; tool *A*, Fig. 11; throw in feed right-hand and left-hand; throw out feed right-hand.

Cut No. 2.—Tool *A* on leather seat, right-hand; run the tool over by hand and start the feed; throw out feed on left-hand cut No. 1. Start feed on second cut left-hand; use gage as shown on right-hand cut No. 2, Fig. 13, and throw out feed; same with left-hand tool.

Cut No. 3. Set tool *A* on the journal bearing; feed tool in to within 1/16 inch of finish size, gage as shown; throw in power feed; same with left-hand tool; gage journal length and throw out feed right-hand; same with left-hand.

Cut No. 4. Set tool *A* on the wheel-fit; start cut and caliper; same for left-hand; gage, and throw out feed; same for left-hand. If two cuts are necessary use 1/8-inch feed for both cuts.

Cut No. 5. Set finishing tool *B* on the collar; chamfer outer edge and throw in feed (1/4 inch); same for left-hand; throw out feed right-hand.

Cut No. 6. Set tool *B* on the leather seat; change to 1/8 inch feed; run carriage over and start feed; throw out left-hand tool on cut No. 5; gage and throw out feed right-hand; start left-hand tool on cut No. 6; gage and throw out feed left-hand.

Cut No. 7. Set tool *B* on the journal; change feed to 1/4 inch; cut down inside of collar; caliper and throw in feed; same with left-hand tool; gage and throw out feed right-hand; same left-hand; finish journal length feeding by hand; same left-hand.

Cut No. 8.—Taper the entering end of wheel-fit, feeding by hand; same left-hand.

Burnishing.—Change feed to 1/8 inch; put in roller right-hand; force roller against journal bearing until desired finish

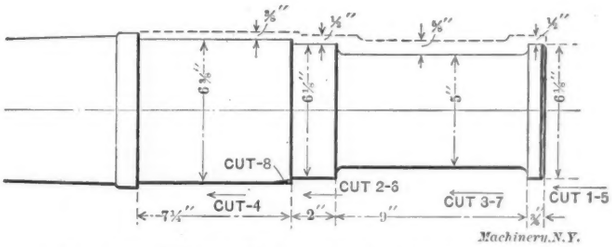


Fig. 14. Master Car Builders Axle, 5 x 9 inch Journal, showing amount of Stock to be Removed.

is obtained; throw in power feed; same with left-hand roller; throw out feed right-hand; throw out feed left-hand; roll large fillet right-hand; same left-hand, feeding by hand.

Change to roughing tools; set to the collar diameter with cardboard between tool and collar; hang the driving dog on the tailstock nose; put sling on axle; draw back the right-hand center; hoist axle clear; run the hoist back on crane arm; swing crane back; lower axle.

By the above routine an axle can be finished with some lost time in from 25 to 30 minutes, and a maximum for a day of ten hours would be from 18 to 20 axles.

It has been stated to the writer, by a reliable observer, that an operator on a Niles motor-driven double axle lathe in the Angus shops of the Canadian Pacific R.R., when "real mad" and on his mettle, had roughed, finished and burnished a 100,000-pound car axle of steel, in 25 minutes, counting from the time of picking up the axle to putting it back on the horse. This was much quicker than the least conservative estimate by the method described, and has been taken as evidence that the writer's estimate is within reason, given that the operator is sufficiently remunerated for the effort, agility and interest required.

* * *

In a recent issue of *Engineering* it is stated that an engine built in 1808, or over a hundred years ago, for a British firm, by Messrs. G. Rennie & Co., of Greenwich, England, has just failed by the breaking of the crank-shaft. The company which built the engine has been called upon to make repairs, and after an examination of the rest of the engine, it was found to be in excellent condition, so that it has been concluded to set it to work again as soon as the repairs have been completed.

DESIGN AND CONSTRUCTION OF ELECTRIC OVERHEAD CRANES—2.

FRAMING AND GENERAL DESIGN OF CRABS.

R. B. BROWN.

The great difference in appearance of electric crabs lies chiefly in the design of the framing. Some very different opinions seem to exist on the primary question of material, the consequent saving of material in the girders. Perhaps, in the case of small crabs, say up to five tons, cast-iron sides may be cheapest, if large quantities are being made, but for larger sizes the steel frames are certainly more advantageous to manufacturer and purchaser alike.

Frames made up of double steel plates, or steel plates framed with angles, are much used, but although they make a substantial crab, nothing special can be said in their favor,

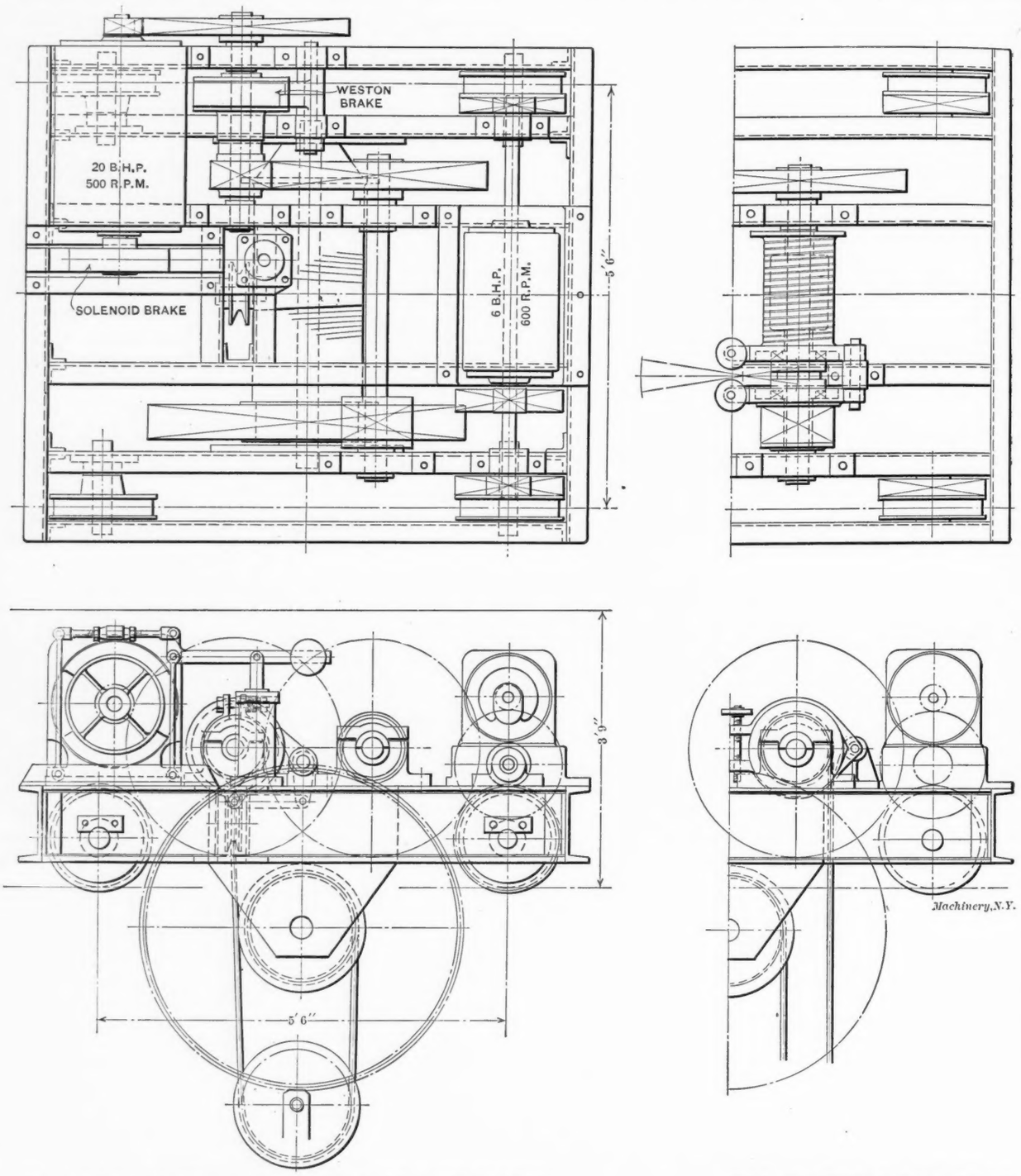


Fig. 4. Crab for 20-ton Three-motor Electric Overhead Crane with Steel Frame.

Fig. 5. Crab, Similar to the one shown in Fig. 4, slightly altered to accommodate Auxiliary Barrel for Light Loads.

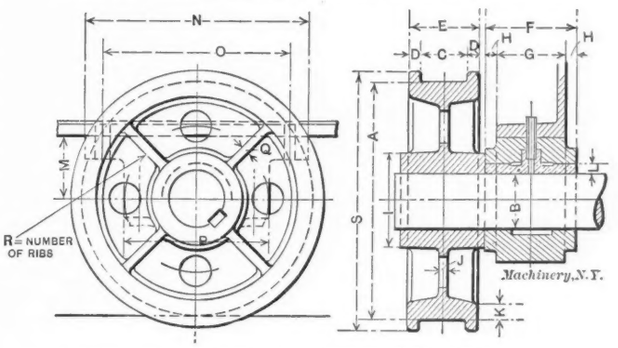
for while certain makers have standard crabs with steel frames for all sizes, others manufacture crabs with cast-iron frames up to a considerable weight. Both types are undoubtedly substantial enough, but there is a limit to their adoption. One of the principal objects in designing an electric crab should be to make the various component parts as accessible as possible for renewal and repair, and in this direction the steel frames, undoubtedly, have the advantage. Another point in favor of steel frames is their lightness, and and they present the same disadvantage as cast-iron sides, in having several closed bearings.

Fig. 4 shows the crab for a 20-ton, three-motor crane with a steel frame of modern design and similar to which large quantities have been made with satisfactory results. Fig. 5 illustrates the same crab, slightly altered to receive an auxiliary barrel for light loads, as sometimes found advantageous. The crab for a four-motor crane is usually of similar construction to the one just referred to, the auxiliary barrel being ar-

ranged to suit the framing of the crab. As will be seen from Figs. 4 and 5, all the bearings in crabs of this type are adjustable, except those for the barrels and perhaps the running wheels, which are bushed; since these latter have slow running shafts, and ample bearing surface can be provided, there is no necessity for adjustable bearings. In the designs shown, it will be seen that the main barrel shaft is so situated that by jacking up the crab it can be drawn out clear of the rails, and the barrel and wheel lowered direct to the ground for rebushing or other attention.

Owing to the variety of designs of crab frames in general use, it is practically impossible to give any definite calculations or details which would be of general value. In the case of small crabs, the smallest convenient sections which can be used are generally strong enough to resist all the strains with a large margin of safety, but with the larger sizes, the strength of the sections should be calculated and the stress limited to 4½ or 5 tons per square inch, in order to avoid possible deflection and subsequent binding of shafts and attendant disadvantages.

TABLE III. DIMENSIONS OF RUNNERS, AXLES AND BEARINGS.



Size of Crane, tons.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	Material.
5– 7½	12	3¼	2½	5/8	3¾	4½	3½	½	6	5/8	3/4	5/16	3	14½	11¼	8½	5/8	4	13½	Cast iron
10–15	15	3¾	2½	3/4	4	4½	3½	½	6	5/8	3/4	5/16	3½	15½	12¼	9½	5/8	4	16½	Cast steel
20–25	15	4	2¾	3/4	4¼	5	3½	¾	6¾	5/8	3/4	5/16	4	16½	13⅜	10¼	5/8	4	16½	Cast steel
30–40	18	5½	2¾	7/8	4½	5½	4	¾	8¾	7/8	1	7/16	5	20	16¾	13½	3/4	5	20	Cast steel
50–60	21	5¾	2¾	1	4¾	6	4	1	9¼	7/8	1¼	½	6	21¼	17½	14½	3/4	5	23	Cast steel

Running Wheels and Axles.

The first question to be considered concerning the crab running wheels is the material, and since they are subject to considerable wear, their durability ought to be considered. For the best class of work, cast-iron runners should not be used for cranes above 10 tons; otherwise the tread may wear quickly, due to the pressure. For crabs below this size, however, cast-iron has been found quite suitable. Crab running wheels should always be made as large in diameter as practicable, and similarly the axles as small as possible, in order to reduce the tractive resistance and consequent current consumption. Table III gives the principal dimensions of runners as usually made, and also the sizes of axles and bearings, which have been calculated as follows:

The axles are subject to combined bending and twisting, the former being due to the overhanging distance, which is generally taken from the center of the wheel to the center of the bearing, to ensure stiffness, and the latter from the resistance to traction at the tread of the wheel. For example, it will be seen from Table III that the runner for a 20-ton traveler is 15 inches in diameter; the wheel pressure will be about 6½ tons. Taking the maximum possible resistance to traction at 90 pounds per ton, we have the torsional moment

$$M_t = \frac{90 \times 6.5 \times 7.5}{2{,}240.} = 1.95 \text{ inch-ton.}$$

The maximum effective overhang may be taken at 5 inches, and consequently the bending moment

$$M_b = 6.5 \times 5 = 32.5 \text{ inch-tons.}$$

The equivalent bending moment M_e may be found by the following common formulas:

$$M_e = \tfrac{1}{2} M_b + \tfrac{1}{2} \sqrt{M_b^2 + M_t^2} = 16.25 + \tfrac{1}{2}\sqrt{32.5^2 + 1.95^2} = 16.25 + 16.3 = 32.55 \text{ inch-tons.}$$

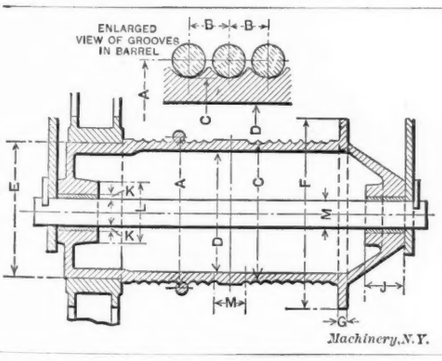
Assuming a stress on the material of 5 tons per square inch, the section modulus is $\frac{32.55}{5} = 6.51$, to which a diameter of 4 inches corresponds.

The working strain in the axles may be increased to 5.5 tons per square inch in the case of crabs of 25 tons and upwards, but it is advisable not to exceed this amount, because even a slight deflection will cause the shaft to bind in the bearings and consequently absorb more power.

After determining the diameter of the axles, sufficient length of journal should be allowed so that the pressure on the bearings is not more than 900 pounds per square inch of projected area. The bearings are usually of cast iron, with a brass lining on the pressure side and fitted with a light cast-iron cap beneath. It is of the greatest importance that these journals should be fitted with proper lubricators, since this provision will lead directly to a reduced current consumption. For crabs of 40 tons and upwards a self-lubricating bearing, as shown in Fig. 6, although more expensive, has been found advantageous. This bearing is designed on the same lines as those which are sometimes fitted to the main traveling wheels. Roller bearings are also occasionally used for these axles.

With crabs of 60 tons and upwards it is generally found more economical and convenient to employ short axles supported by a bearing on either side. By this means much smaller journals can be used, and at the same time the gearing can be more compactly arranged since there are no cross axles to clear. One wheel on each side has to be geared with this arrangement.

TABLE IV. DIMENSIONS OF LIFTING BARRELS.



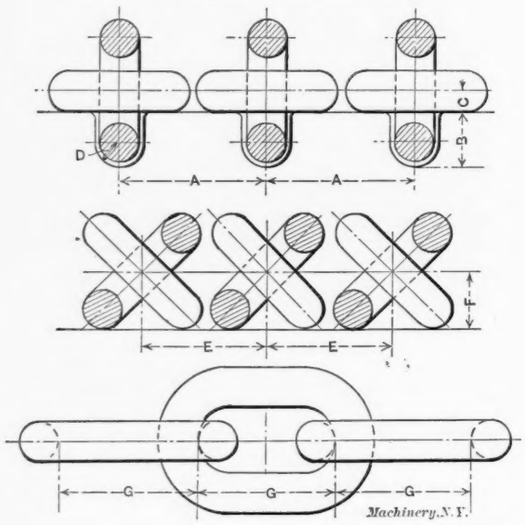
Load, tons.	Number of Ropes.	Size, Circumference, inches.	A	B	C	D	E	F	G	H	J	K	L	M
3	2	1¾	12	5/8	11.45	10⅛	9⅞	12½	5/8	2½	3½	5/16	5	2½
5	2	2¼	15	¾	14.30	13	12¾	15⅝	¾	2¾	3½	5/16	5½	2½
7.5	4	2	12	11/16	11.37	10⅛	9⅞	12⅝	5/8	2¾	3½	5/16	5½	2½
10	4	2¼	15	¾	14.30	12⅝	12¾	15¾	¾	2¾	3½	5/16	5½	2½
15	4	2¾	16½	1	15.62	14½	13⅝	18½	¾	3⅛	4	3/8	6½	3
20	4	3¼	18	1⅛	17.00	15¼	14¾	19½	1	3¼	4	3/8	6½	3
25	4	3½	21	1¼	19.90	18	17½	22¼	1¼	4	4½	7/16	8	4
30	4	4	24	1⅜	22.70	20½	20	25⅛	1¼	4¾	4½	7/16	8¾	4
40	4	4½	27	1½	25.50	23	22½	28⅛	1½	5	5	7/16	9¼	4½
40	4	5	30	1¾	28.40	30	29½	32	1½	5½	5½	7/16	10	4½

Barrels, Ropes, and Chains.

Lifting barrels are invariably made of cast iron, cast blank for rope, and the grooves turned out to suit. For chain falls

the grooves are generally cast in. Practically all modern travelers are now fitted with wire rope falls, the alternatives being ordinary chain and pitch link of Gallé chain, the latter being used mostly on the European continent, or for special cranes. Table IV gives particulars of steel ropes suitable for lifting purposes and drums or barrels for same. The factor of safety usually adopted for lifting rope is eight, which allows a good

TABLE V. DIMENSIONS OF CRANE CHAINS.



Size, inches.	Load, tons.	Weight per Foot, pounds.	A	B	C	D	E	F	G
$\frac{3}{8}$	1	1.5	$1\frac{7}{16}$	$\frac{17}{32}$	$\frac{3}{16}$	$\frac{1}{4}$	$1\frac{1}{8}$	$\frac{1}{2}$	1
$\frac{7}{16}$	1.3	2.0	$1\frac{5}{8}$	$\frac{19}{32}$	$\frac{7}{32}$	$\frac{9}{32}$	$1\frac{9}{32}$	$\frac{37}{64}$	$1\frac{1}{8}$
$\frac{1}{2}$	1.7	2.7	$1\frac{13}{16}$	$\frac{21}{32}$	$\frac{1}{4}$	$\frac{5}{16}$	$1\frac{5}{16}$	$\frac{11}{16}$	$1\frac{3}{8}$
$\frac{9}{16}$	2.1	3.3	$2\frac{1}{16}$	$\frac{3}{4}$	$\frac{9}{32}$	$\frac{11}{32}$	$1\frac{13}{32}$	$\frac{3}{4}$	$1\frac{9}{16}$
$\frac{5}{8}$	2.7	4.1	$2\frac{1}{4}$	$\frac{13}{16}$	$\frac{5}{16}$	$\frac{3}{8}$	$1\frac{25}{32}$	$\frac{53}{64}$	$1\frac{5}{8}$
$\frac{11}{16}$	3.3	4.8	$2\frac{1}{2}$	$\frac{29}{32}$	$\frac{11}{32}$	$\frac{13}{32}$	$1\frac{29}{32}$	$\frac{29}{32}$	$1\frac{7}{8}$
$\frac{3}{4}$	3.9	5.9	$2\frac{11}{16}$	$\frac{31}{32}$	$\frac{3}{8}$	$\frac{7}{16}$	$2\frac{1}{32}$	1	$2\frac{1}{8}$
$\frac{13}{16}$	4.6	6.8	$2\frac{7}{8}$	$1\frac{1}{32}$	$\frac{13}{32}$	$\frac{15}{32}$	$2\frac{1}{4}$	$1\frac{1}{16}$	$2\frac{1}{8}$
$\frac{7}{8}$	5.4	8.1	$3\frac{1}{16}$	$1\frac{3}{32}$	$\frac{7}{16}$	$\frac{1}{2}$	$2\frac{1}{2}$	$1\frac{5}{16}$	$2\frac{3}{8}$
$\frac{15}{16}$	6.2	9.0	$3\frac{1}{4}$	$1\frac{5}{32}$	$\frac{15}{32}$	$\frac{17}{32}$	$2\frac{5}{8}$	$1\frac{1}{4}$	$2\frac{1}{2}$
1	7.0	10.3	$3\frac{1}{4}$	$1\frac{1}{4}$	$\frac{1}{2}$	$\frac{9}{16}$	$2\frac{3}{4}$	$1\frac{5}{16}$	$2\frac{1}{2}$
$1\frac{1}{16}$	8.0	11.3	$3\frac{3}{8}$	$1\frac{9}{32}$	$\frac{17}{32}$	$\frac{19}{32}$	$2\frac{15}{16}$	$1\frac{13}{32}$	$2\frac{9}{16}$
$1\frac{1}{8}$	8.9	12.5	$3\frac{3}{4}$	$1\frac{5}{16}$	$\frac{9}{16}$	$\frac{5}{8}$	$3\frac{1}{16}$	$1\frac{15}{32}$	$2\frac{15}{16}$
$1\frac{3}{16}$	9.9	14.3	4	$1\frac{13}{32}$	$\frac{19}{32}$	$\frac{21}{32}$	$3\frac{1}{8}$	$1\frac{9}{16}$	$3\frac{5}{16}$
$1\frac{1}{4}$	10.9	15.8	$4\frac{1}{4}$	$1\frac{1}{2}$	$\frac{5}{8}$	$\frac{11}{16}$	$3\frac{7}{16}$	$1\frac{21}{32}$	$3\frac{3}{8}$

margin of strength even after a few strands have broken. The life and value of the rope depends to a great extent on the size of the barrel and pulleys around which it has to pass. Some rope makers recommend a barrel diameter of six and a half times the circumference of the rope. This is quite suitable and convenient for cranes using ropes under 3½ inches

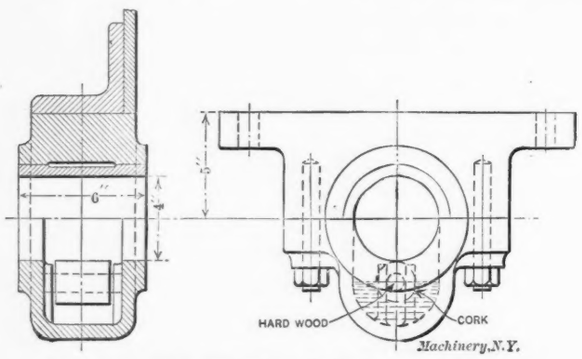


Fig. 6. Self-lubricating Bearing for Shafts in Crabs of 40 ton Capacity and larger.

circumference, but above this size it has been found satisfactory to make the barrel and pulleys from five and a half to six times the circumference.

Another point of importance is the spacing of the ropes or centers of the grooves. For all sizes up to 4 inches circumference, it is necessary to allow one-eighth inch between the ropes, but above that size three-sixteenths inch gap should be provided, if possible. This allowance is due to the fact that the ropes flatten out slightly under the load, and if there is not sufficient side clearance they grind against each other and are likely to break some of the strands.

When chain is used, it is of the type known as short link crane chain, having a breaking strain of about 23 tons per square inch, and is usually stressed from four and a half to five tons per square inch under the working load. Table V gives working loads and dimensions of standard crane chains, and shows the spacing and leading dimensions of suitable chain barrels. The length of the lifting barrel is a quantity which naturally depends on the height of lift, but when

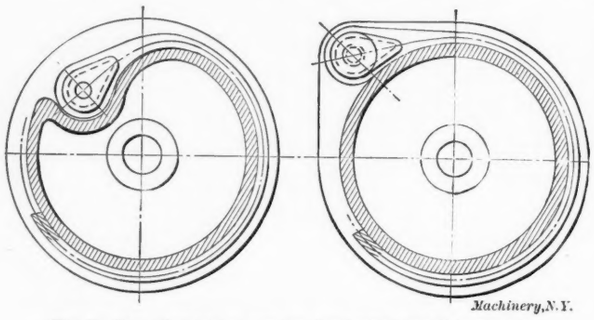


Fig. 7. Two Methods in use for Anchoring the Lifting Ropes.

designing a standard traveler, it is advisable to allow for sufficient rope to give a vertical lift of thirty feet with two spare coils on either end, this being the maximum height required under ordinary conditions.

Chain falls should be avoided for longer lifts than twenty feet, otherwise the barrels become inconveniently large. The principal reason for providing the spare coils referred to is to reduce the strain on the anchors, which, however, should always be strong enough to take the full load. Several methods of anchoring the rope are in use, of which probably the two methods shown in Fig. 7 are the best. In either case, a solid cast iron eye is woven into the end of the rope, and a hole drilled in the eye for a turned pin or stud. This makes a very substantial connection.

It has become universal practice to so arrange the lifting ropes or chains that the load will be lifted centrally and thereby distribute the load equally over each girder. This arrangement is necessary for all cranes above five or seven tons, from which size up to fifty tons the loads should be lifted on four parts of rope, two parts being coiled in right- and left-hand grooves on the barrel, the other end passing around a compensating pulley, as will be seen by referring to Fig. 4. This pulley need not be more in diameter than about twice the circumference of the rope, since it is not subjected to any motion. For cranes up to and including three tons the load should be lifted on a single fall, while for loads of five, six, and seven tons it is more convenient to employ two parts, one coiling on the barrel. There is practically no advantage in providing a central lift for these light cranes, since

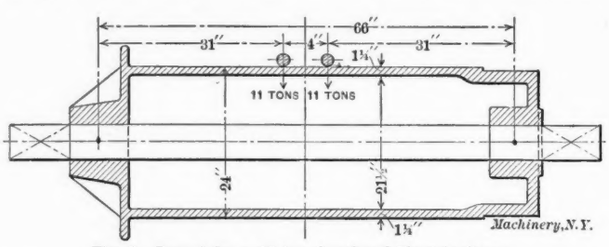


Fig. 8. Barrel for a 40-ton Overhead Electric Crane.

it is generally impracticable to make the girders light enough to give an ordinary working strain and the little extra weight that will be thrown on one girder will not destroy the economy of construction.

The barrels used for ordinary overhead travelers seldom exceed 30 inches in diameter, and up to this size the method shown in Table IV of fixing the barrel to the wheel has been found to be the cheapest and is almost universally adopted. The thickness of metal in the barrel should be sufficient to resist the maximum bending which occurs when the load is

in the highest position and the ropes are in the center. If the stress from bending is not greater than about 0.75 ton per square inch there will be an ample margin of strength left to safely provide for the compression from the ropes themselves. For example take a forty-ton crane barrel as shown in Fig. 8. The maximum span over which bending takes place is from center to center of the bearings, and the maximum bending moment $M_b = 11 \times 31 = 341$ inch-tons.

$$\text{Section modulus of annulus} = \frac{\pi}{4} \times \frac{R^4 - r^4}{R} = \frac{\pi(12^4 - 10.75^4)}{4 \times 12}$$

$= 483.$

$$\text{Stress} = \frac{341}{483} = 0.7 \text{ ton per square inch.}$$

The size of the barrel shaft should be made sufficient to take the bending from the center of the support to the center of the bearing at a stress of about 5 tons per square inch, and the length of the bearing should be such that the pressure on same is about 900 pounds per square inch.

* * *

FLOATING CHUCK FOR FACING GEAR BLANKS.

As we have before remarked, there is much more to the problem of obtaining accurate gears than is involved in careful attention to the cutting operation itself. For instance, having the finished teeth run true involves more than simply having a true running work arbor, especially if the blanks are mounted on the arbor in gangs and are cut several at a time. Under such conditions, it is very necessary to have the blanks accurately faced in parallel planes, exactly normal to the axis of the central hole. If this matter is disregarded, the blanks will spring the gang arbor very much out of true when tightened on it.

Various methods are followed to produce parallel faces. One of these, used in the shops of the Cincinnati Shaper Co., employs a special tool slide with roughing and finishing facing tools, arranged to operate on both sides of the blank, which is keyed to a drive arbor. This method was described in connection with the builders' key-seating attachment in the new tools department of the September, 1908 issue of MACHINERY. Other methods that the writer has seen tried, involve the grinding of the sides of the blanks, which are

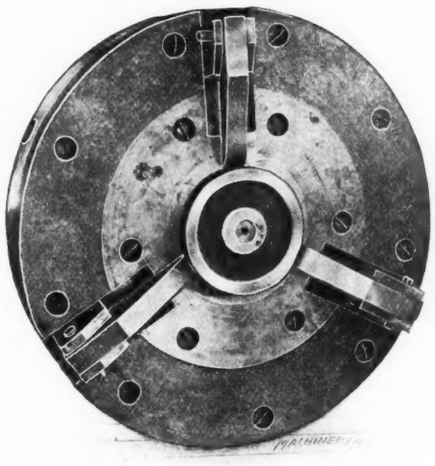


Fig. 1. A Chuck for Facing Gear Blanks, which holds them without Side Strain or Distortion.

held on magnetic chucks in special face grinding machines. This operation is not done for the sake of any fineness of finish or accuracy in the thickness of the finished product, but simply for the purpose of obtaining accurate gear cutting in the case of blanks mounted in gangs.

One of the most ingenious and satisfactory solutions of this problem that has come to our notice is that followed in the shop of the Fellows Gear Shaper Co., of Springfield, Vt., where it is used particularly for finishing blanks such as those used for change gears, which are made in large quantities. The first operation on these blanks consists in facing one side and chucking the hole, in an ordinary turret lathe. The only point worth mention in this operation relates to the necessity for taking enough cuts across the face and through the bore to insure that these two surfaces shall be finished very accurately with relation to each other.

After this operation has been completed, the blanks are faced on the unfinished side in the chuck shown in the accompanying illustrations. This is the most interesting operation, as the chuck is decidedly novel in its action. As may be seen in Fig. 2, where it is shown dismantled, the device was made from an old scroll chuck of the usual construction,

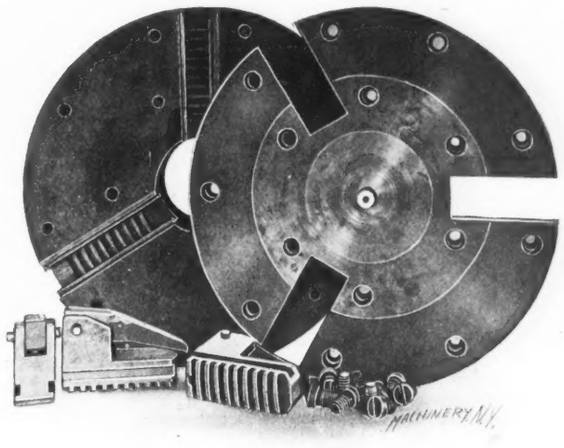


Fig. 2. The Chuck Dismantled, showing Clamp Jaws and Floating Scroll.

which had become so worn that its accuracy was more than questionable. What little accuracy it had left was, in fact, eliminated, by machining out the seat for the scroll to a greater width, so that it could float in the groove with 1/8 inch or so of movement. Special jaws of the kind shown in Fig. 2 were next made, fitting the scroll and the slides in the body of the chuck, and provided with pivoted holding-down dogs and "spuds," similar to those commonly used for holding thin work on the planer. Over the face of the chuck was screwed the plate shown, which was provided with a central hole in which was driven a stud closely fitting the bore of the gear blank.

The use of this chuck will now be clearly understood. In Fig. 1 the blank is seen placed on the stud, with its finished face against the plate. Each time the chuck is placed on the machine, this plate is refaced, and a new plug is put in and turned down to fit the bore of the hole. If the lathe is in a reasonably good condition, assurance is then given that the locating surfaces for the work will run with the utmost accuracy. The work being placed on the stud and pressed with its finished face against the plate, the jaws are screwed down, with the edges of the dogs pressing against the periphery of the blank in such a way as to hold it firmly against the plate. It will be seen that the loose fit of the scroll in its seat equalizes the pressure on the three sides of the blank, so that it is simply pressed backward into position, without the possibility of being forced sidewise and out of true in any direction. When the facing is completed on a blank thus held, every assurance is given that the face will be true with the bore, parallel with the finished surface on the opposite side of the blank.

The final turning operation is done on a gang arbor, mounted in the spindle of the lathe. The utmost accuracy in turning the periphery of the blank is not necessary, although, if the gang arbor is true, the preceding operations will insure good work in this final turning. Finishing the work in gangs like this reduces the cost of this operation to a very low figure even though it requires three operations. It might perhaps be done somewhat more cheaply by a set of screw machine tools that would finish the blanks in one operation (using special chuck jaws, back facing attachment, etc.), but the greater truth obtained by this method makes the operation less costly in the long run if quiet running gears are desired.

RECENT DEVELOPMENTS IN GEAR-CUTTING MACHINERY.

RALPH E. FLANDERS.*

The past year has been one of great activity in machine design, as is plainly shown by the files of contemporary technical journals. In no line has this activity been more marked than in that of gear-cutting machinery in its various forms.

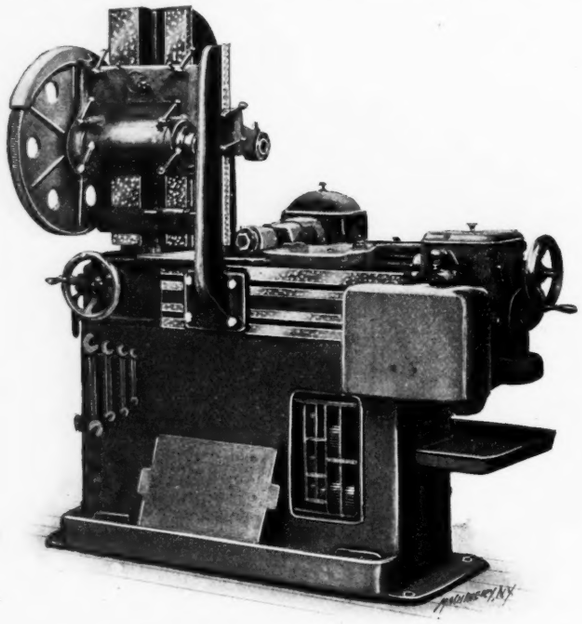


Fig. 1. A German Automatic Spur Gear Cuttér which shows the Influence of American Design.

In the months covering the publication of the author's series of articles on this subject (see the issues of MACHINERY from January to September, 1908) the department of New Machinery and Tools illustrated a number of designs which were not included in the articles. Several new examples of foreign gear-cutting machinery have also come to light. This article will briefly describe such of these machines as have not previously been illustrated. The classification of the series of articles referred to will be followed.

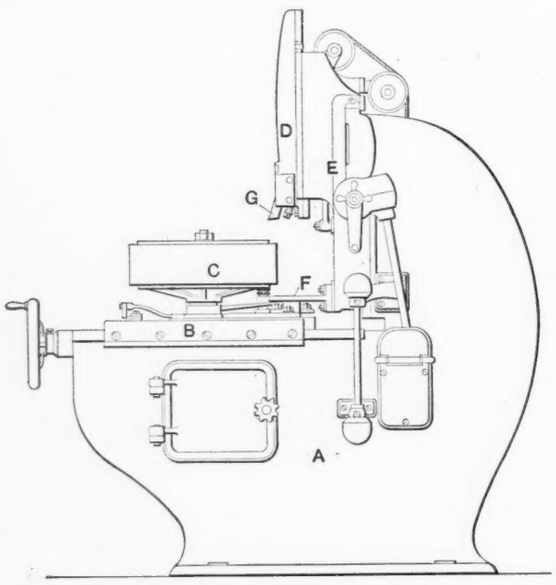


Fig. 2. Elevation of a French Spur Gear Generating Machine employing a Rack Tooth Form of Shaper Tool.

Machines for Cutting the Teeth of Spur Gears.

In Fig. 1 is shown a German machine of the orthodox type which shows American influence very strongly. The mechanism is carefully enclosed, fixed handles are provided for all the adjustments, and the usual form of rim rests, outboard supports, etc., are also provided. The speed and feed changes, as well as the indexing, are effected by change gears. This machine is built by Shubert & Salzer, Chemnitz, Germany.

Two new machines have been developed in Europe for cutting spur gears on the molding-generating principle by the shaping operation. A tool, which is given the shape of a rack tooth, is fed in the direction of the travel of an imaginary rack, past the gear blank, which is, at the same time, rotated in the proper ratio. The first of these machines, shown in Figs. 2 and 3, is built by the Société Francaise de Machines-Outils, St. Ouen, Paris. The resemblance of this machine to a slotter is at once evident. The work, which is shown mounted on the work arbor at *C*, is carried by table *B* which is adjusted in and out on the bed *A* of the machine to give the adjustment for diameter. The tools *G*, having the outline of the rack tooth, are mounted on a ram *D*, which is, in turn, guided in a cross slide *E*, which travels on a cross rail solid with the frame of the machine. In cutting a tooth, the tool starts in at one side of the blank, and the ram *D* on cross slide *E* is fed from right to left, in the face view of the machine. This lateral motion is transmitted by means of rack teeth on arm *F*, engaging suitable mechanism on the work table for rotating work *C* in unison with the lateral movement of the tool. When one tooth has thus been cut, and the slide *E* has been returned to the starting point, the work is indexed, and a second cut is taken in the same manner—and so on until all the teeth are cut. The capacity of this machine is for work up to 20 inches in diameter.

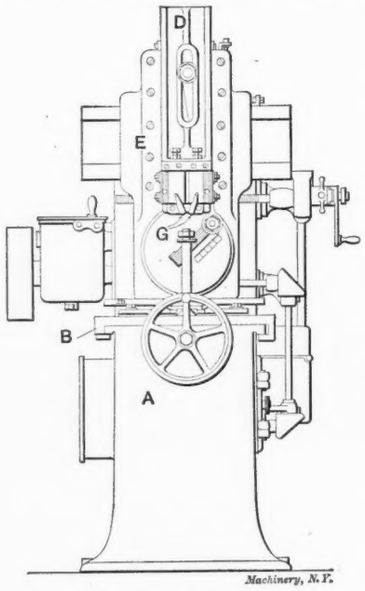


Fig. 3. The Face View of Spur Gear Generating Machine.

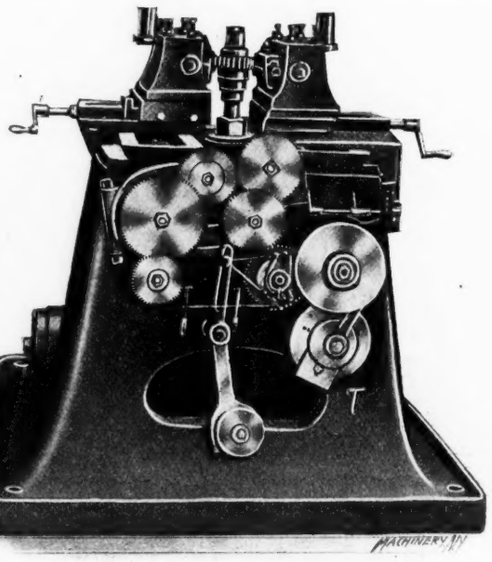


Fig. 4. An English Spur Gear Generating Machine employing Multiple Tools of Rack-shaped Outline.

The second machine is built by Spencer & Spiers of Huddersfield, England. The construction and movements are entirely different from the previous example, though the principle is the same. There are two sets of tools *AA*, as shown in the plan view Fig. 5, disposed on opposite sides of the work *B*. Each of these tools is formed of several rack teeth.

* Associate Editor of MACHINERY.

As the work is reciprocated up and down between them by crank *G* and connecting-rod *F*, these tools are fed in the direction of their pitch line in opposite directions, and the work is revolved in unison at the proper ratio. To effect this, the tools are mounted on parallel slides *E*, which carry racks

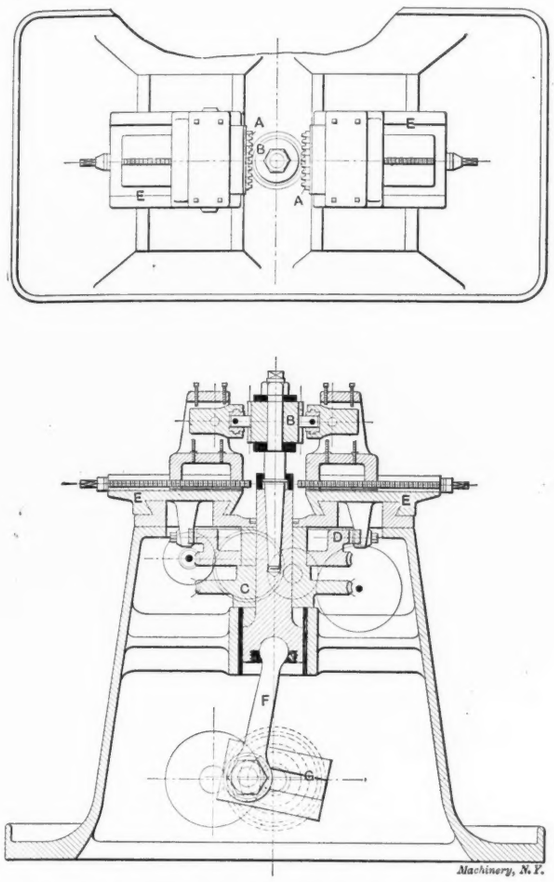


Fig. 5. Plan and Vertical Section through the Machine shown in Fig. 4, with Details of Controlling Mechanism.

engaging gear *D*, within the base of the machine. *D* also has worm-wheel teeth cut on it, driven by a worm which is connected by change gearing with worm-wheel *C*, which rotates the work. Owing to the fact that the two tools have several teeth each, it is possible to finish pinions and small gears at one passage. For larger gears, provision is made for bringing the tools to the starting point again, and taking a second cut, with the work turned to present a new portion of the periphery to the action of the cutting edges.

The makers of this machine state that no outboard supporting bearing for the work arbor has been found necessary, owing to the fact that the cuts are perfectly balanced. This is effected by the use of the two tools, one on each side of the work. A larger machine has been built in which the tool slides reciprocate vertically instead of the work, the latter being mounted on a spindle which revolves as the cutters are fed past it. The design illustrated in Fig. 4 has been somewhat improved in later models.

The activity in the design of hobbing machines also continues unabated. Four new examples of this class of gear cutters are shown herewith. The first of these is built by the Ateliers de Constructions Mecaniques ci-devant Ducommun, Mulhouse, Alsace. As may be seen in Fig. 6, it has the appearance of being of unusually rigid construction. The work spindle head slides through an opening in the column, being firmly supported in all directions. A heavy outboard bearing of the usual form is provided. The work spindle head is counterbalanced. As nearly as may be judged from the engraving (definite information on this point is lacking) the machine is also arranged for the cutting of spur and spiral gears by the formed tool process. The dividing plate for hand indexing will be seen below the index wheel at the left of the engraving.

Another machine of the same type, built by Gildemeister & Co., A. G., Bielefeld, Germany (see Fig. 7), is of the more usual form in which the cutter spindle is carried on the column while the work table is adjusted on the bed. Fig. 8 shows this machine cutting a spiral gear with a formed cutter. This operation requires very little change in the mechanism needed for straight spur gear hobbing, it being only necessary to connect the change gears for driving the work spindle with the feed-screw, instead of with the cutter spindle, and to provide means for hand indexing. The wide provision of this arrangement on European machines is doubtless due to the patent restrictions on the spiral gear hobbing process.

Another hobbing machine, built by Wilhelm Junghans Werkzeugmaschinenfabrik, Chemnitz, Germany, has the base and column in one solid casting (see Fig. 9). It is also provided with elaborate rim and work supporting arrangements, there being an outboard bearing for the spindle, and rim supports both front and back. This machine is designed for hobbing spur and worm gears. It is also provided, when so desired, with hand indexing mechanism for cutting pur gears with formed cutters.

Mention might be made here of a rather unusual extension of the hobbing process, and one which at first thought would seem to be impracticable. This is reported in a paper read before the British Institution of Mechanical Engineers in July, 1908, on "The Evolution and Methods of Manufacture of Spur Gearing" by Mr. Thomas Humpage, the maker of a hobbing machine previously illustrated. Mr. Humpage relates that he has experimentally built and used a corundum "hob" for finishing gears on which a few thousandths had been left for grinding. In using these hobs or worms, the tool is adjusted axially so that one side of the thread touches one side of the teeth of the work. The wheel is then fed down automatically, grinding one side of all the teeth and generating them to the finished form. The machine is next stopped, the wheel raised by hand, and a finishing cut taken. The other sides of the teeth are then ground and finished in the same way. The author proposes to make a machine using a hob of this kind in which a device like that on the fly-tool worm-hobbing machines will be used for traversing the corundum to distribute the wear across its length. It is found that the wear on the worm is very slight, being

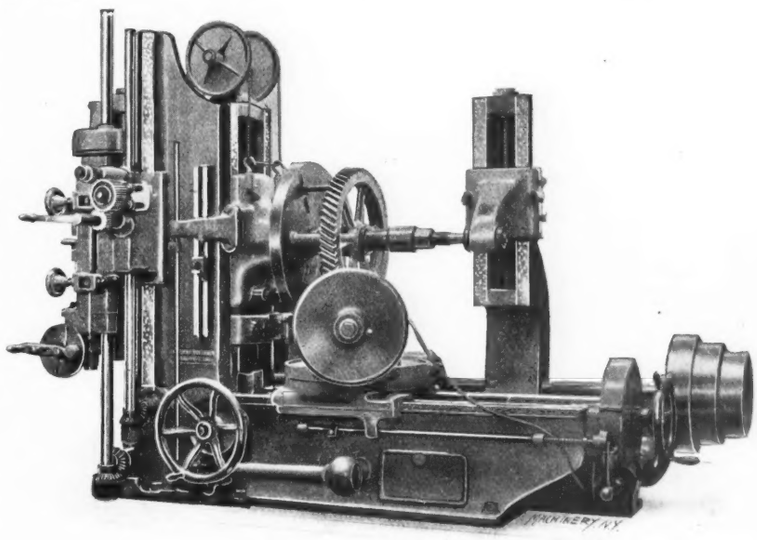


Fig. 6. Ducommun Gear-hobbing Machine cutting a Spiral Gear.

about a thousandth of an inch in the worn part for cutting a 70-tooth, 7-pitch, 1¼-inch face cast iron wheel, which was finished in eight minutes. In the complete machine, the author proposes to mount a corundum wheel for truing up

the worm. He suggests also that this finishing process should be applied to all gears, whether soft or hardened.

Machines for Cutting Internal Gearing.

The only new development in cutting internal gearing which has come to the writer's notice during the past year is that shown in Fig. 10, which illustrates the surprising operation of hobbing an internal gear. This operation bears the same

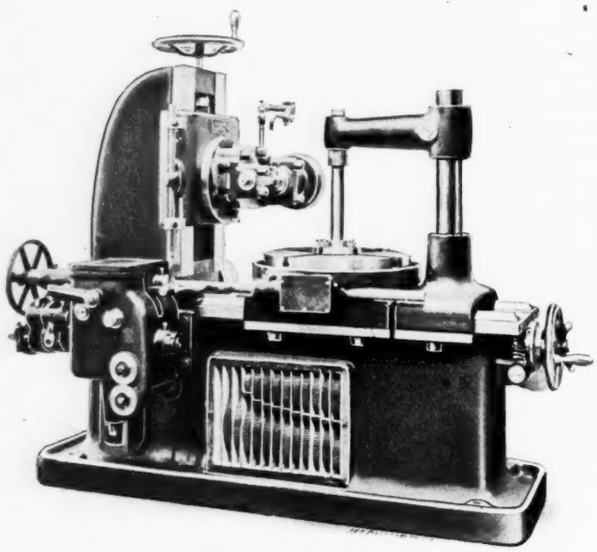


Fig. 7. The Gildemeister Gear Hobbing Machine.

relation to the hobbing machine in which it is done, that the use of an internal gear-cutting attachment bears to the orthdox spur gear cutting machine. The method of driving through a train of gearing connecting the cutter with the regular spindle, is identical. With this attachment, the hob has a pitch surface of a barrel-shaped form, with the radius of curvature corresponding with the pitch radius of the wheel to be cut. In producing these hobs, a master internal toothed wheel is hardened, so that the teeth act as cutters. The soft hob blank is then placed in the machine the same as when at work, as shown in Fig. 10, and a theoretically correct profile is generated on it by the hardened internal wheel. The hob itself is then relieved, hardened and ground ready for use. It is adapted only to cutting gears of the diameter and pitch for which it was made. David Brown & Sons, Huddersfield, England, are the originators of this device.

Machines for Cutting the Teeth of Worm Gears.

A machine similar to those illustrated in Figs. 119 to 128 of the previous series of articles, has recently been placed

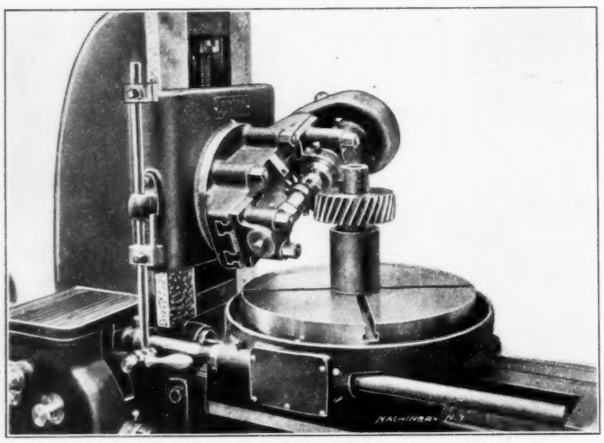


Fig. 8. The Gildemeister Machine cutting a Spiral Gear by the Formed Tool Process.

on the market by J. Holroyd & Co., Ltd., Perserverence Works, Milnrow near Rochdale, England. The machine is, of course, under the classification given it, adapted for using either a tapered hob or a fly tool for cutting the teeth of worm-wheels. The cutter bar is moved axially for the feed, and is so connected by differential gearing with the worm-wheel revolving the work spindle as to keep the tool and work constantly in register. This machine, as may be seen in Fig. 11, is similar in general design to that illustrated in Fig. 122, in that the work spindle is vertical and stationary as to location on the bed, while the cutter slide is carried by a column horizontally adjustable for the diameter of the work. The machine is of unusual size and capacity. It will hob wheels from 12 inches to 72 inches in diameter. The main bearing of the work spindle is 8 inches in diameter by 16 inches long. The approximate weight of the whole apparatus is ten tons. This same firm builds a machine of similar design for smaller work in which, however, the work spindle, instead of the cutter slide column, is horizontally adjustable.

Machines for Cutting the Teeth of Bevel Gears.

A firm in Budapest, Hungary, whose name translated into English reads "Small Arms and Machine Factory Co., Ltd.," has built for a number of years the templet bevel gear planer shown in Fig. 12. In this machine the work spindle is adjustable for the pitch cone angle, by moving it in a concave circular seat in the bed. This seat keeps the axis of the work spindle always in line with the horizontal axis of the swiveling adjustment. The outer end of the work arbor is supported in a yoke which swivels about this axis. The mechanism on the upper part of the machine is the tool head, which carries two crank-driven slides, each of which carries a tool. These slides are confined by guides which are pivoted about an axis passing through the apex of the pitch cone. The whole mechanism swivels about the horizontal axis passing

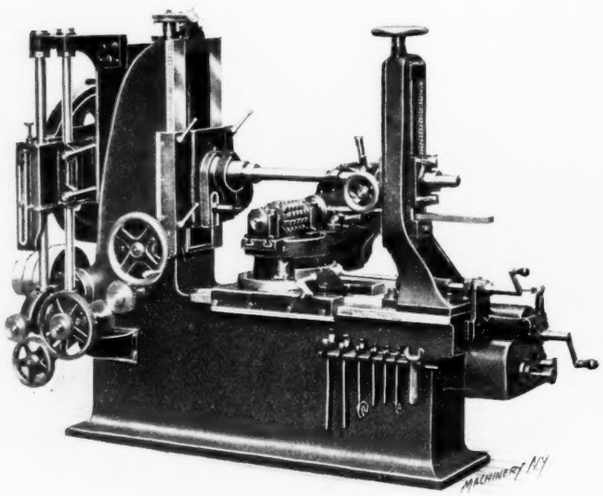


Fig. 9. Junghans Spur Gear Hobbing Machine.

through the same point. As the tools are swung down into the teeth about this horizontal axis, they are spread apart about the vertical axis by the action of fingers on each tool slide guide, which bear on opposite sides of a suitably formed templet, held in the templet holder at the upper right of the machine. The swinging downward of the tool slide mechanism is accomplished by a revolving nut on the swiveling screw which connects this mechanism with the bracket to which the templet is clamped. This latter is held in slides which are adjustable for both vertical and horizontal movement. In having the tools swivel about both axes while the work remains stationary, this machine resembles the Gleason machine shown in Fig. 151. It is not, however, automatic.

In Figs. 13 and 14 is shown a recently developed templet machine for finishing the teeth of bevel gears, made by Earl H. Browning, of the Browning Engineering Works, Cleveland, Ohio. As in the previous case, two tools are used, each mounted in separate slides which are swiveled about a common horizontal axis passing through the apex of the pitch cone of the gear to give the desired outline to the tooth. This swiveling of the cutter slides under the action of the templet takes place simultaneously with the swinging of the work-carrying head about a vertical axis. That is to say, as the tooth of the gear is swung in between the points of the tools the latter are opened up with the proper movement to give the

desired tooth outline. As the points of both tools travel toward the apex of the pitch cone of the gear, the outline of the templet is reproduced on a decreasing scale from the large to the small end of the tooth. In the details of the design this machine is original. One of the points of novelty is the use of the quick change speed gear box seen on the work spindle head in Fig. 13, for the indexing mechanism. This gear box, in combination with a further change of four ratios, gives the entire range for cutting any ordinary number of teeth without the use of loose change gears. The changes of speed and feed are also effected by quick change gear boxes. Fig. 14 shows a face view of the cutter slides, with the tools in place in the tool-holders. The line of movement of the cutting points of the tools is toward the apex of the pointed rod shown at the center of the swinging attachment of the slides. In this machine, the templet, which is not here shown, is in the form of a cylindrical cam, which is rotated in unison with the swinging of the work spindle head around the bed. This cam has two grooves, each of which controls a roller attached to the outer ends of the tool slide guides, which are thus controlled.

An English machine of the molding-generating type operating on the shaper principle is shown in Fig. 15. Here the

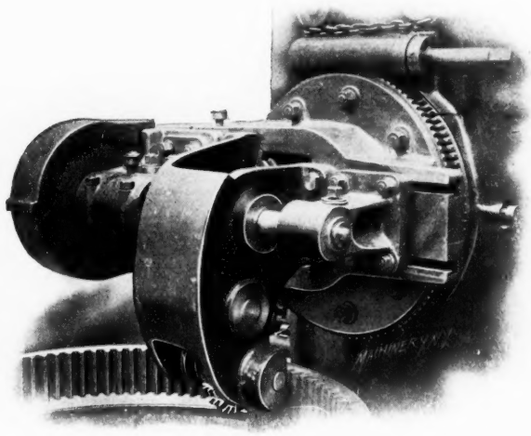


Fig 10. An Attachment for Hobbing Internal Gears.

axes of both the work and the imaginary crown gear are staticnary, the blank and the tool swinging about these axes. The proper ratio of rolling movement of these two parts is obtained by change gears. The machine has two distinctive features not found in other generating machines, so far as the writer is aware. One of them is the provision made in the mechanism for automatically gashing the wheel preparatory to the finishing generating cut. In this operation the blank is swung around into the reciprocating tool, the slide being locked in position, until the proper depth has been cut. It is then returned rapidly and the work is indexed for the next cut, which is taken in the same way. This swinging of the work into the cutter and back again is effected by the adjustable crank shown at the front of the machine, which has a slow ratchet feed for cutting to depth, and a quick movement for returning. This same crank mechanism is used without the slow ratchet feeding for bringing the cutter into depth for starting the generating cut, and swinging it back at its completion to clear for the automatic indexing in the finishing operation. The other distinguishing feature of this machine is the provision made for correcting the teeth for interference. In other generating machines, this correction is made by altering the addendum and dedendum of the gear and pinions in cases where it is necessary. In this case it is done by modifying the tops of the teeth the same as in the standard shapes for spur gears. To accomplish this the swiveling movement of the tool slide is retarded as the tool is leaving the point of the tooth. A slotted cam groove will be seen, cut in a sector which is fastened behind the outer end of the swinging tool slide. This cam groove controls the movement of a short slide, which, in turn, by means of the diagonal groove and block shown, gives a relative movement

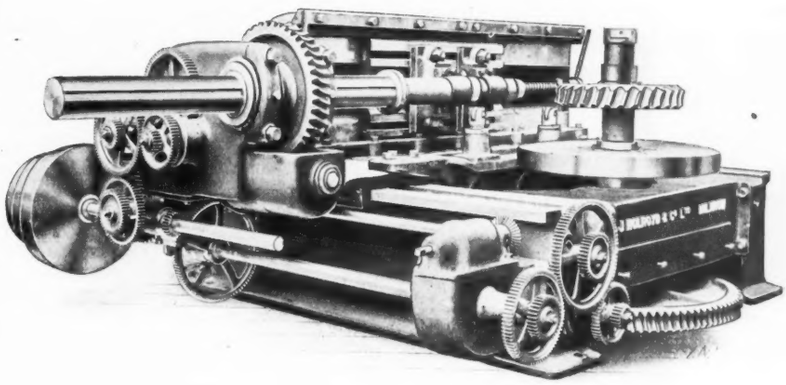


Fig. 11. The Holroyd Worm Gear Generating Machine using a Fly Tool or Taper Hob.

between the slide itself and the sector on which it is mounted. This movement is sufficient to trim the tops of the teeth as required. The builder of this machine is the Churchill Machine Tool Co., Ltd., Manchester, England.

* * *

The United States Geological Survey's annual report on the mineral resources in the United States for 1906 has just been issued. It appears that the value of the metallic products of the country in 1906 was $866,110,856 and of the non-metallic $1,016,194,350. Coal is the most important of the mineral products and iron comes second, the value of the products of each in 1906 being slightly more than $500,000,000. Copper comes third with a value of $177,595,888. The clay products come in the fourth place, gold occupies the fifth

Fig. 12. A Hungarian Templet Bevel Gear Planer.

place, and petroleum the sixth. It is noteworthy that the lead output of the country exceeds that of the silver output. The greatest increase in the year is shown in the production of coal, copper, and cement. Pennsylvania produces nearly one-third of the mineral output of the country, Ohio one-tenth, and Illinois, New York and West Virginia occupy, respectively, the third, fourth and fifth places as mineral producing states.

CENTRIFUGAL PUMPS.*

E. N. PERCY.†

Many engineers agree that it is only a matter of time and development when centrifugal pumps will displace the reciprocating type for most classes of work. Owing to their high speed, they occupy little space, and as they have no moving parts except the runner, there is less complication and repairs; consequently, they are more reliable, and give less trouble.

Centrifugal pumps are admirably adapted for direct connection with electric motors, steam turbines, steam or gas engines, or belt drives when high speeds are necessary. They run silently, there are no pipe shocks, nor is an air chamber necessary. If the discharge valve is closed, no harm results, as the pressure does not rise, and the load on the pump is removed; hence, like a shunt wound dynamo, it is self-regulating, only doing work in proportion to the quantity of

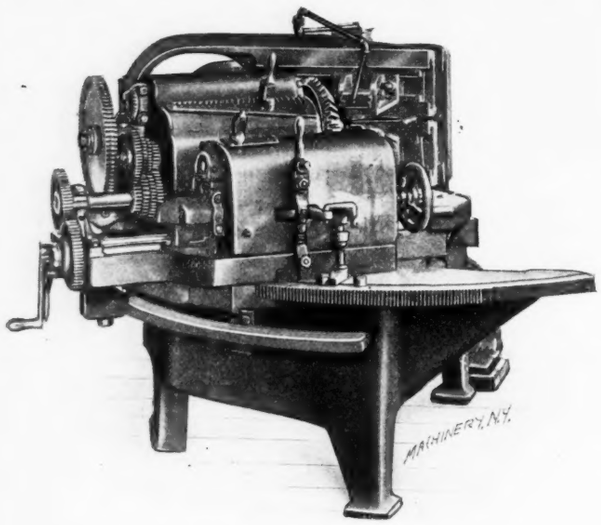


Fig. 13. The Browning Templet Bevel Gear Planer.

water pumped (approximately). A battery of centrifugals can be connected in series for one duty, requiring high pressure, and in parallel for another duty requiring low pressure and great quantity. The motor and pump are always directly connected and can operate without any foundation, even at the end of a rope in a deep well. For fire service, there is no danger of bursting hose or pipes; for this reason, if for no other, there should be a special field for them in Tammany fire departments. This type is also adapted to the handling of beers, chemicals, and other liquids liable to contamination or erosion in action, as there are no valves or other details to cause trouble.

The common, commercial, volute pump seldom gives over 45 per cent efficiency, but can easily be designed to give 65 per cent, and be manufactured just as cheaply. A high-duty pump for a special condition will give 88 to 90 per cent efficiency, but, so far, these results have been confined to European makes, American manufacturers not securing much over 80 per cent at official trials. The multi-stage pumps are divided into two classes, the commercial and the high duty. They operate at various speeds dependent upon innumerable conditions. For the best efficiency, any centrifugal pump operates at but one speed. Pumps without guide vanes can have a fair efficiency over a very wide range of speed, owing partly to the fact that the suction column adjusts its rotation to some extent to suit the runner speed. The velocity of a high-speed pump can be reduced with only a slight falling off in the efficiency, but the low-speed type becomes inefficient very fast on being speeded up, because of the excessive eddies in the casing. With a high-duty pump provided with guide vanes, any change of speed is attended with great efficiency losses, because of the eddies between runner blades and guide vanes. If variable speed is a necessary feature,

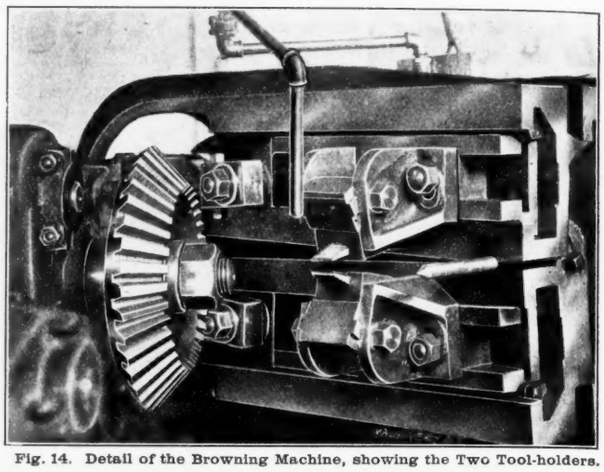


Fig. 14. Detail of the Browning Machine, showing the Two Tool-holders.

the guide blades must be movable to suit conditions, as in a variable speed water turbine. When the quantity of water varies (as by adjusting the discharge valve), as before, the plain volute pump has a fair efficiency over a wide range of variation, but the high-duty pump again suffers from eddies between the runner and guide vanes. In this case, also, it is customary to have variable guide vanes if a high efficiency for all conditions is desired. When one considers the commercial efficiency, which includes cost of repairs, reliability, spare parts, silence, and space occupied, the centrifugal pump is entitled to a high rating.

Of the various powers for driving centrifugals, the electric motor, steam turbine, steam engine, and gas engine, are all far more economical than the ordinary steam pump using from 40 to 80 pounds of steam per horse-power per hour. When used in municipal waterworks service, the pumps can be run in parallel for ordinary service work, and connected in series for fires or flushing the mains. Many cities have this system, particularly in the West. When used in connec-

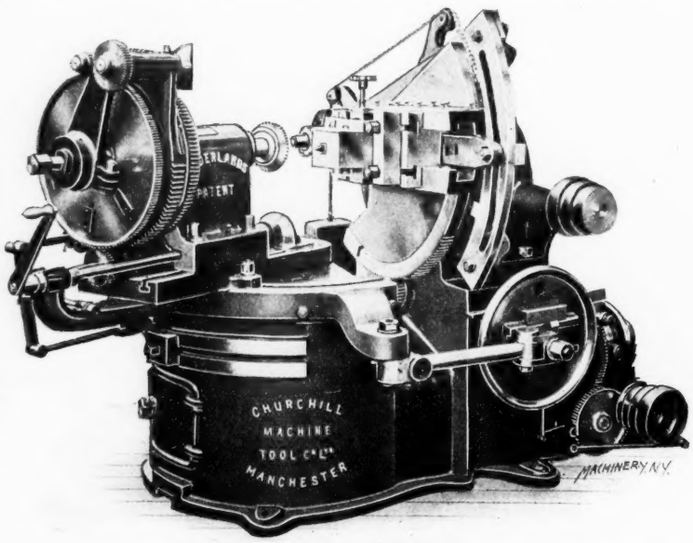


Fig. 15. The Churchill Bevel Gear Generating Machine, in which Provision is made for Modifying the Teeth to avoid Interference.

tion with tank supply, a float valve may be placed at the end of the discharge valve, as the pressure cannot rise when the valve closes, and the power necessary varies as the quantity of water pumped, with an additional variation due to change of efficiency.

Of late, it has been customary to supply large buildings and hotels with a regular system of piping for ice water. It

* For additional information on this and kindred subjects, see the following articles previously published in MACHINERY: Centrifugal Pumps, April and January, 1907; A New Method of Pumping Heavy Crude Fuel Oil or Other Thick Viscous Fluid, July, 1906; The Commercial Pumping Engine, February, 1906; The Limit in Pumping Machinery, August, 1905; Pumping Heavy Fluids, April, 1905.

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is obvious that this must be an endless system, with constant circulation. There is no better nor more economical method than to have this maintained by a small centrifugal pump. No roof tank is necessary, although it is often used, as the pump can maintain the service, and a spare pump is cheaper than a tank, since they are so small. If a closed pressure tank is used at the bottom, the upward and downward moving columns balance, and the pump has only friction and weight of water actually used to overcome. A tank at the top gives a reserve capacity, and it may be either open or closed, but it is a source of loss by convection of heat, due to water remaining there.

One of the chief uses of centrifugals is in the irrigation of land. Their small first cost opens up a field hitherto precluded by the cost, complication, upkeep, and lack of economy of reciprocating pumps of the same capacity. Now, the farmer can, by a small gas engine or wood-burning steam engine and a centrifugal pump, irrigate his land from a nearby stream, canal or lake, and the cost is so nominal for small lifts as not to need serious consideration. The extreme height of lift for profitable irrigation seems to be around 170 to 200 feet, varying with conditions such as quality of land, cost of fuel, and value of crop. Irrigation on a large scale has been most successfully practiced by pumping, and plants up to 1,000 horse-power are in use.

Centrifugal pumps are now used in many large power plants as feed pumps, as they have many advantages over the ordinary type. There is no pipe shock or noise, and they work quietly, without air chambers, at a continuous speed, regardless of the quantity of water handled. Of course, the efficiency varies, but it is fairly good for a wide range of work, and at the worst, when driven by an electric motor or steam turbine, the centrifugal pump uses less steam than the reciprocating type. As a condenser circulating pump, the centrifugal's good points are well known. It is probable, however, that in the future, circulating pumps in large plants will be smaller and run at a higher speed, driven by an electric motor or steam turbine. For the handling of sewage, or bilge water full of ashes, coal, debris and grease, the centrifugal type of pump has no equal. In fact, many a good ship has gone down because the valves of a reciprocating pump became clogged at a critical time. This type can be operated while submerged in the bilge, the power being transmitted by a vertical shaft running to a motor or turbine placed above the pump.

As a mine sinking pump, the centrifugal has made its reputation. It is compact, being self-contained, and highly efficient. For regular mine pumping stations, the multi-stage pump, with a waterproof electric motor, needs neither engineer nor a dry station. In fact, it will run entirely submerged. Whereas the steam pumping station needed a complete engineering crew, many repairs, and a complete duplicate plant to insure safety. Deep tube wells 10 and 12 inches in diameter are now pumped by submerged multi-stage pumps driven by highly-efficient electric motors, which is preferable to the single cylinder deep well steam pump, using from 60 to 100 pounds of steam per horse-power hour, and requiring careful operation, and many repairs.

All over the city of Berlin, Germany, are numerous beautiful fountains. Near each is a small electro-centrifugal pump drawing water from the canals which cross the city in every direction, and discharging it to the fountain. They have no attendant, and are never shut down, or attended to in any way, except by an inspector who looks at them several times a week, seldom, however, doing anything to them. What reciprocating pump could perform this duty without being practically rebuilt every year or two? [The life of any pump depends, of course, greatly upon the chemical properties of, and the amount of grit in the liquid being pumped. Under favorable conditions, well-constructed reciprocating pumps will often run for years without giving any great trouble and without requiring much attention.—EDITOR.] In a like manner, in those parts of the country where electricity can be obtained from power lines, pumps driven by motors can be set up for irrigation or other purposes, and no attention paid to them for weeks at a time. This may not be advisable, but it is actually the case in many western farming communities.

For wrecking, salvaging, and dry dock work, the centrifugal pump holds supreme sway because of its portability and cheapness. For the draining of land and marshes it has been used exclusively by the Dutch and by the engineers who have drained the Ferrarri Marshes of Northern Italy; the two greatest pieces of reclamation known to history. Of course, this refers to the time of modern pumping, since the Dutch have ceased to depend on windmills. The use of centrifugal pumps for hydraulic dredging has done much to improve our harbors and cheapen canal work. When made properly, they even endure this terrific wear, which could not even be thought of in connection with a reciprocating pump. As a lubricating pump for large systems of forced lubrication, the centrifugal maintains a constant pressure, no matter what the conditions of lubrication are, nor how often they change. In hydraulic elevator service, it is the ideal pump, because, without governors or regulating apparatus of any kind, it maintains a constant pressure, always supplying all the water necessary, up to the limit of its horse-power, and works equally well under pressure tank or open system. It could be used to advantage with hydraulic hoisting or manufacturing machinery. Steam turbine driven centrifugals have been applied to some of our most prominent fire boats, and they are now recognized by the underwriters, provided certain conditions relative to priming, etc., are met with.

To sum up, the centrifugal pump is a very modern piece of machinery, the growth and importance of which, in this country, is just beginning to be realized.

* * *

TO DETERMINE SIZE OF GAS AND OIL ENGINE CYLINDERS.

NEWTON WRIGHT.*

The determination of the size of a gas engine cylinder from the heating value of the fuel, and the pressure caused by the theoretical rise of temperature, is impractical, as the losses due to incomplete combustion, cooling effect of jacket, and incomplete expansion, cannot be estimated with any great degree of accuracy. The size is most conveniently determined from the known fuel consumption of engines of similar power and type, provided the ratio of air to gas is also known. The formulas given in this article will aid in determining the size required, in this manner. In the formulas given the notation used is as follows:

d = diameter of cylinder in inches,
s = stroke in inches,
n = revolutions per minute,
H = brake horse-power per cylinder,
c = cubic feet of gas per brake horse-power hour,
w = pounds of oil per brake horse-power hour,
r = ratio of air to gas or vapor,
r_1 = ratio of air and products of combustion (in clearance space) to gas or vapor,
k = ratio of total capacity of cylinder to piston displacement,
V = piston displacement per stroke in cubic inches,
V_1 = piston displacement in cubic inches per brake horse-power,
v = clearance volume in cubic inches,
m = ratio of diameter to stroke.

One pound of heavy oil gives about 12 cubic feet of vapor, and one pound of light oil about 6 cubic feet; consequently, in applying the following formula for the ratio of air to gas or vapor, to oil engines, 12 w and 6 w, respectively, are substituted for c. The value of the ratio r is expressed by the formula

$$r = \frac{d^2sn}{cH \times 72} - 1.$$

The ratio r varies from 2 to 3.3 for producer gas, from 7 to 12 for lighting gas, from 27 to 40 for vapor of heavy oil, and from 36 to 52 for the vapor of light oil. With the most economical engines the value of r lies between the two figures given, but is generally nearer the lower than the higher. Per-

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haps the average figures would be with producer gas, 2.4, lighting gas, 9; heavy oil, 30; and light oil, 40. In the two last instances, this value of the ratio would make 360 cubic feet of air per pound of heavy oil, and 240 cubic feet of air per pound of light oil.

The value of the ratio of air and products of combustion (in clearance space) to gas or vapor is expressed by the formula:

$$r_1 = \frac{d^2snk}{cH \times 72} - 1.$$

The ratio k of total capacity of cylinder to piston displacement is given in Table I.

TABLE I. RATIO OF TOTAL CYLINDER CAPACITY TO PISTON DISPLACEMENT.

Absolute Compression in Pounds per square inch.	k	Absolute Compression in Pounds per square inch.	k
30	2.65	75	1.46
45	1.86	90	1.38
60	1.58	105	1.33

The value of k is higher than it apparently would be, as the heating of the air following the compression causes the pressure to rise in a greater ratio than that due to the actual compression. When means are taken to clear the cylinder of the products of combustion, as is usual with engines working on producer gas, then r_1 will equal the ratio of pure air to gas.

The value of the piston displacement per stroke, in cubic inches, V, is expressed by the formula:

$$V = \frac{Hc\,(r+1)\,57.6}{n}$$

The relation between the diameter of the cylinder and the other quantities affecting it, is expressed by the formula:

$$d = 4.2\sqrt{m}\sqrt[3]{\frac{Hc\,(r+1)}{n}}$$

The ratio of the diameter to the stroke m equals, of course, $\frac{d}{s}$, or $d = sm$. From the formula given it will be seen that if the length of stroke is given, the power of the engine will be proportional to the square of the diameter, but if the ratio of the diameter to the stroke is given, the power will be proportional to the cube of the diameter. Table II gives the usual values of m employed.

The clearance volume is determined by the formula,

$$v = V\,(k-1) = d^2s \times 0.7854\,(k-1).$$

The total volume of the cylinder equals $V + v = Vk$.

TABLE II. COMMON VALUES FOR QUANTITIES ENTERING IN CALCULATION OF SIZE OF GAS AND OIL ENGINE CYLINDERS.

Fuel Used.	H	c or w	n	m	V_1
Producer Gas.....	20– 50	85	170	0.6	100
	50–100	80	160	0.7	100
	over 100	75	150	0 9	100
Lighting Gas.....	to 5	30	300	0.5	60
	5–20	25	220	0.5	66
	20–50	20	170	0.6	70
	H	w	n	m	V_1
Heavy Oil.....	to 5	1.2	300	0.5	87
	5–20	0.9	220	0.5	88
	20–50	0.7	170	0.6	90
Light Oil..... ...	to $1\frac{1}{2}$	1.	750	0.6	19
	5	0.75	750	0.8	14

The compression varies from 35 to 80 pounds per square inch, and is usually about 75 pounds. The piston speed in feet per minute is from 400 to 700 in gas and heavy oil engines of less than 200 H.P. per cylinder, up to 1,000 in the largest engines. In light oil engines the piston speed is seldom less than 650 feet per minute, even in the smallest sizes, and more in the larger.

Assuming a consumption of 80 cubic feet of producer gas per brake horse-power, 25 cubic feet of lighting gas, 0.9 pound of heavy oil and 0.75 pound of light oil, and taking the average values of r as given in the first part of this article, the following formula may be employed for finding the diameter of the cylinders, if the ratio between the diameter and the length of stroke is given.

$$d = f\sqrt[3]{m}\sqrt[3]{\frac{H}{n}} = \frac{f\sqrt[3]{m}}{\sqrt[3]{\frac{n}{H}}}$$

In this formula f is a coefficient which equals 27.2 for producer gas, 26.4 for lighting gas, 29 for heavy oil, and 24 for light oil. At ordinary speed H would equal, approximately, $\frac{d^2}{5}$ for producer gas, $\frac{d^2}{4}$ for lighting gas, $\frac{d^2}{6}$ for heavy oil, and $\frac{d^2}{4}$ for light oil. These formulas, however, will not hold good for very small engines, say under 10 H.P., except for those using light oil.

The heating value of the fuel is usually as follows: Producer gas, 150 B. T. U. per cubic foot; lighting gas, 660 B. T. U. per cubic foot; heavy oil (specific gravity about 0.88), 20,000 B. T. U. per pound; light oil (specific gravity about 0.69), 28,000 B. T. U. per pound.

As has been mentioned before, one pound of heavy oil gives 12 cubic feet of vapor and one pound of light oil about 6 cubic feet, so that the heating value per cubic foot of vapor is 1,660 with heavy oil, and 4,660 with light oil.

Taking the average ratios of r as given before, the heating value of the mixture of air and gas drawn into the cylinder per cubic foot is, with producer gas 45, with lighting gas 66, with heavy oil 55, and with light oil 114. If the clearance space is allowed for, and assuming 75 pounds compression, the figures are 37, 48, 37 and 80, respectively. A theoretically perfect engine requires 2,545 B. T. U. per horse-power-hour, corresponding to a consumption of 17 cubic feet of producer gas, 3.9 cubic feet of lighting gas, 0.125 pound of heavy oil, 0.091 pound of light oil. If the efficiency of the gas producer is taken into account, minus 0.182 pound of anthracite or 0.212 pound of slack as one pound of coal, the producer gives about 62 to 70 feet of gas.

The preceding formulas refer to ordinary 4-cycle single-acting engines. For engines with several cylinders, the power, fuel consumption, etc., should be taken for one cylinder alone, and if a double-acting cylinder, the power, fuel, etc., for one end.

* * *

From a note in the *Mechanical Engineer* for December 25, 1908, it is evident that English mechanics and engineers are also feeling the need of more intimate connection between technical education and shop practice. A committee of the North-east Coast Institution of Engineers and Shipbuilders has made the suggestion that apprentices be divided into two classes, one to be known as "ordinary apprentices" and the other as "pupils," the latter receiving rather more wages and also serving six years' apprenticeship, half of this to be passed in the works and the other half at college. For "ordinary apprentices" it was recommended that preference should be given to those with the highest leaving certificates at the elementary day school, where the committee recommend youths intending to qualify as artisans should receive, when possible, some instruction in elementary science, and that each year they would be given marks for examinations, time-keeping, good conduct, industry, and progress, bonuses being given for exceeding a certain number of marks. The pupil class will be trained to recruit the ranks of draughtsmen, managers, superintendents, employers, etc. Those who have passed a three years' course in engineering at a university college and obtained a certificate from it, would be taken as pupils for a three years' course, and in other cases workshop experience and college study would be combined for a period of six years, the pay to be higher after the first year's college course. Ordinary apprentices would be promoted to the pupil class on passing suitable examinations, during the course of their apprenticeship.

PACKING MACHINE TOOLS FOR EXPORT.

Machinery for export must be packed in a much more thorough manner than is necessary for domestic shipping, if it passes unharmed the rough handling it inevitably receives. It is generally sufficient for domestic shipment to crate a machine simply, as it probably will not be turned over or roughly handled in the course of transportation, and even may not leave the car on which it was loaded until it reaches its destination. In the case of foreign shipment the condition is entirely different. It is shifted from one vehicle to another many times in its course and is very unceremoniously handled. A box containing a machine tool worth thousands of dollars is of no more importance to a stevedore than one containing dog biscuit. Even if carefully handled, there is the effect of storms at sea to be considered. The pitching and rolling of a vessel in seaway may cause great damage to a machine improperly packed in its box. All machinery for foreign shipment must be braced in its boxing in such a way that it will not shift position or throw great loads on slender parts even when lowered into the hold of the steamer with the machine on end or upside down.

Many American machine tool builders have boxed their machines very poorly, the result being that when received by European agents, parts were found broken, and the machines in a generally bad condition. Oftentimes the breakage of a small part has delayed putting the machine into use, weeks or even months, the consequence being that the customer is dissatisfied with the delay, and often sales have been lost by the breakage of a trifling small part which the agent was unable to promptly replace. The subject of packing machinery for export was very ably handled in a paper contributed by Mr. Paul Roux to the American Chamber of Commerce, Paris (see MACHINERY, April, 1904) in which our manufacturers were warned of the bad effect on foreign customers, produced by lax practice in preparing for foreign shipment. But some American builders had learned the lesson thoroughly long before that time and for years have packed their machines in a way that leaves little for criticism.

The accompanying photographs illustrate the very thorough and substantial way in which machine tools built by the Gisholt Machine Co., Madison, Wis., are prepared for foreign shipment. The company has developed the practice illustrated, through experience, and since it began following this method of boxing and packing, it has virtually eliminated all complaint regarding bad condition of machines received by its customers across the water.

Fig. 1 shows a Gisholt turret lathe in the strong frame made for foreign shipment, on which the outside covering of boards has not yet been nailed. It will be noticed that the very substantial framing is tied together by long ½-inch bolts, thus strongly reinforcing the joining of the timbers at the corners. The posts are made of 4 x 6-inch hemlock, and the remainder of the frame of 4 x 4-inch hemlock. The flooring is made of 2 x 10-inch hemlock and the skidding of 4 x 6-inch No. 2 hemlock. For boarding the outside of the case, No. 2 shiplap is used.

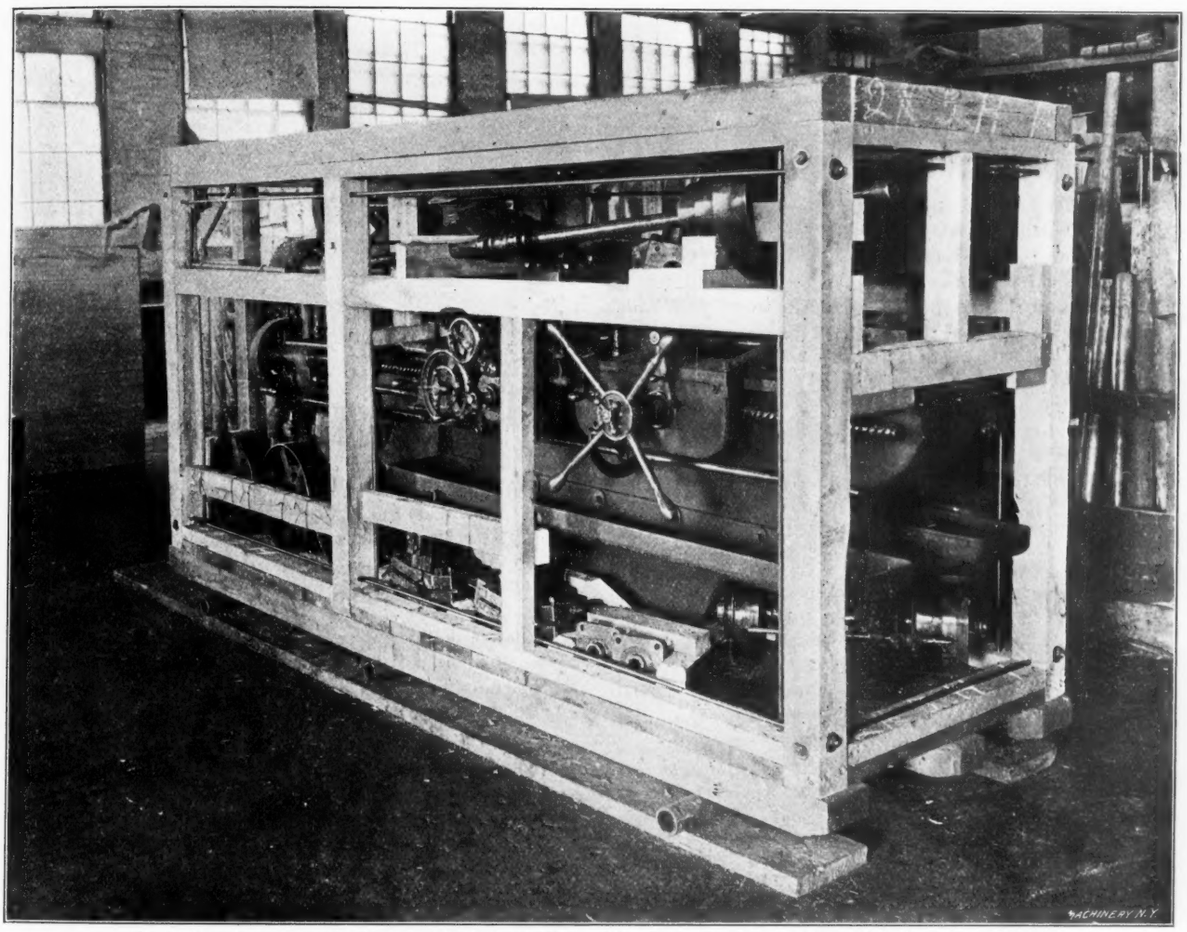

Fig. 1. Framing of Export Case for Gisholt Turret Lathe. Note Size of Framing, and Through-bolts tying it together.

Figs. 2 and 3 are two views of a case containing the bed, table, feed box, head-stock, shields, etc., of a 42-inch Gisholt boring mill. The same specifications in regard to posts, overhead work, skids and boarding used for boxing the turret lathe, apply to the boring mill. Fig. 4 shows a case containing the top rail, down slides and cross-rail of the same machine, while Fig. 5 shows a case containing the housings. In these casings the use of ½-inch through-bolts is not found necessary as the weight of the parts is not so great as to rack apart the nailing of the timbers.

In Fig. 6 two machines completely boxed and loaded on a car ready to move out of the shop are shown. All bright parts of the machines are thoroughly slushed with No. 98 "Cosmic" slushing compound, while the tops of the machines are covered with tar paper. Then on top of the completely enclosed case is fastened a layer of waterproof paper lined with burlap, thus making a tight roof and insuring the machines from

becoming wet when exposed to storms on wharves. Some manufacturers have overdone the waterproofing act by lining the case throughout with tarred paper. Such a lining prevents circulation of air and causes dampness to collect which rusts finished surfaces even though protected with slushing compounds.

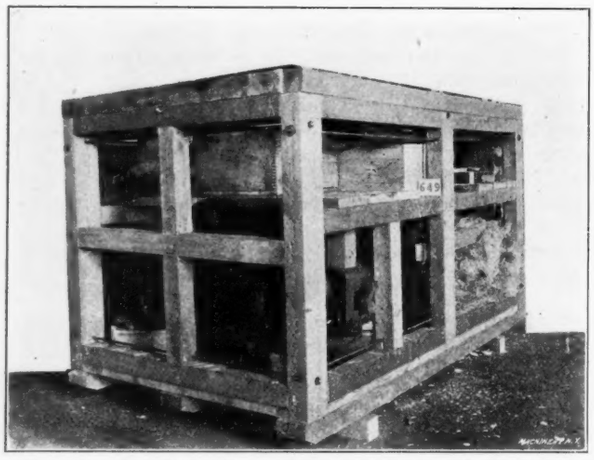

Fig. 2. Framing of Export Case for Gisholt 42-inch Boring Mill—Bed, Table, Feed-box, Head-stock, etc.

Special note should be taken of the thorough way in which the accessory parts are cleated down, and the manner in which heavy parts are supported by the framing. The proper preparation of a heavy machine so as to withstand foreign shipment is costly of time, labor and lumber, and much thought should be given to the design of package. Much can be learned in the latter regard from a careful study of these illustrations. It must be remembered that in lowering a machine into the hold of a steamer it is quite possible that the box will be suspended with the machine upside down, or what may be worse, from one end if it is too long to go down the hatchways horizontally. No slender part should be in

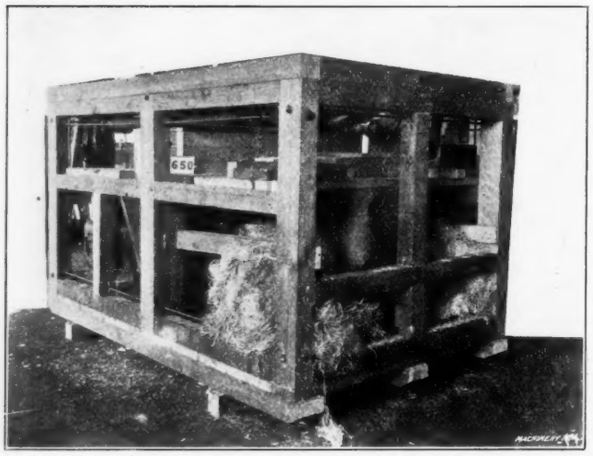

Fig. 3. Framing of Export Case for Gisholt 42-inch Boring Mill—Bed, Table, Feed-box, Head-stock, etc.

contact with the thin boarding, as a blow or heavy pressure may be transmitted to the part with bad effect. The dropping of a case is not an unknown accident, and, of course, no framework sustaining a heavy machine will withstand a drop of many feet, but a drop of a few feet should not be disastrous, and is not likely to be, if boxed as here illustrated. Following is a summary of the principal points that should be observed in packing machines for export:

1.—Dismount all projecting slender parts to save space and to prevent breakage by side pressure. Saving of space is important as 40 cubic feet is reckoned a ton even if the actual weight is less.

2.—Avoid packages weighing more than 4½ tons if possible. The freight rate is much higher for packages exceeding this limit than for lesser weights. Keep all weights less than two tons if it can be accomplished without making assembly too difficult.

3.—In dismounting machines take into consideration ignorance of the parties receiving it, and avoid as much as possible dismounting parts that require careful adjustment for the successful working of the machine.

4.—Fill all the screw holes with wood or waste soaked in slushing oil, to prevent filling with dirt and rust.

5.—Tag all parts removed, giving their position or use on the machine.

6.—Prepare a list of all the detached parts to accompany the machine, which will show if any part has been lost in transit or custom house examination. Assembled drawings or photographs are desirable also, to facilitate erection.

7.—Cover all finished parts with a reliable slushing oil to prevent rusting during transit. The salt air and dampness of the sea voyage will attack unprotected finished parts to an extent almost unbelievable by one having known only the protection needed for land transport.

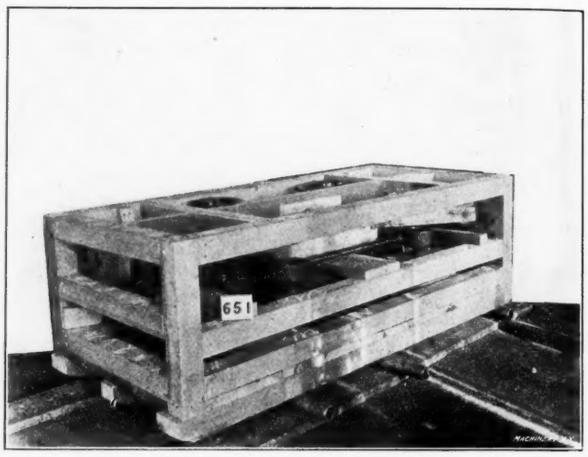

Fig. 4. Framing of Export Case for 42-inch Gisholt Boring Mill—Top-rail, Down-slides and Cross-rail.

8.—Build the package with strong skids, floor and framework, reinforced by through-bolts, if large, heavy machines are to be shipped without dismounting the frames from the legs.

9.—Support all heavy overhanging parts with cross girts from side frames, and pack accessory parts so that they cannot change position even if the case is overturned.

10.—Provide a waterproof roof and board the sides so as to resist driving storms of rain or snow. Leave an opening 12 x 18 inches in one side, the cover of which can readily be

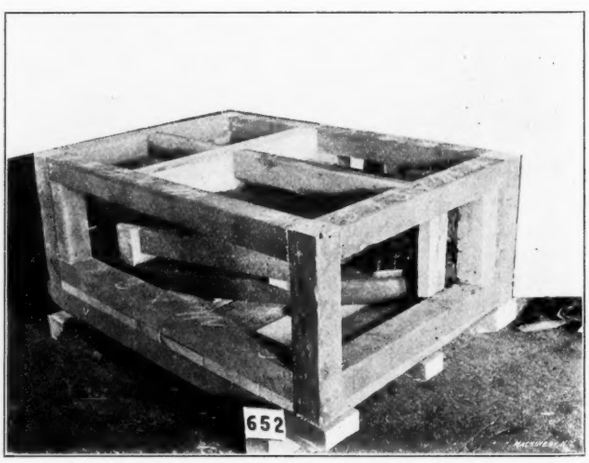

Fig. 5. Framing of Export Case for 42-inch Gisholt Boring Mill—Housings.

removed for custom house examination. Mark the screws holding the panel so that they will readily be found and removed without damaging the case.

11.—Mark the case with the gross and net weight, volume in cubic feet, port of destination, names of consignee and shipper, name, number and capacity of machine; also designate the top or bottom and the nails or screws that should be first removed in unpacking.

DISTINCTIVE COLORS FOR PIPING IN A MANUFACTURING PLANT.*

OSCAR E. PERRIGO.†

There has recently been a good deal of discussion on the subject of painting the piping of a power plant in distinctive colors for the purpose of identifying the use of the various lines of pipe. The subject has appeared to be of sufficient importance to attract the attention of the members of the American Society of Mechanical Engineers, and a proposition has been made to standardize a system of colors which it is assumed should be somewhat suggestive of the use of the pipes and easily memorized by even the dullest intellect in the plant.

For many years the writer has been an advocate of the principle of making use of the well-known peculiarity in the minds of men to quickly recognize colors and their significance in preference to any amount of printed or written directions that can be given. Thus, in the pattern-shop a certain set of distinctive colors was given to patterns to indi-

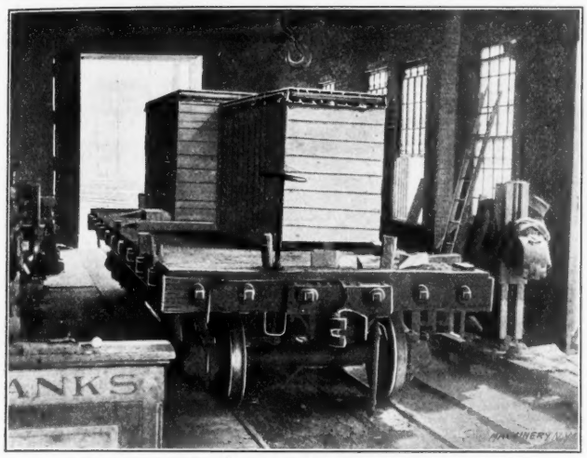

Fig. 6. Two Machines completely boxed and loaded on Car Ready for Shipment.

cate the metal of which they were to be cast, and to indicate what part of a pattern was to be cast in metal and what parts were the cores and the core-prints. In one establishment which had all its castings made outside the plant, much difficulty and annoyance had been experienced by having patterns sent to the wrong foundry, or ordered of the wrong metal. The result of the method of using distinctive colors worked so well that in seven years' use not a single casting was sent to the wrong foundry or made of the wrong metal. This seemed to prove the practical value of the system.

In the shop and office systems, the cards and blanks used had their distinctive colors, indicating their individual purposes, or the departments in which they were used. The men soon learned the signification of the colors, with no instruction whatever. Cards and blanks were habitually referred to by their colors rather than by the titles printed at the top. The work of sorting, arranging, and of generally handling them was greatly lessened and the question of efficiency favorably affected.

In the year 1891 the writer took charge of a manufacturing plant that had been started in "the good old times" (about 1850) in one small building, and which had been remodeled and added to at various times as the necessities of the business required, until it comprised no less than thirteen buildings and additions. There had been no general plan by which this work of development had proceeded, but each successive addition had been made to meet the emergencies of the hour and without much consideration for the future needs of the business. The result, so far as shafting, piping, transportation facilities, etc., were concerned, was much complication and a perplexing growth representing a maximum of expense and a minimum of efficiency. To bring something like order out of the chaos of piping, was a task that can be better appreciated by a man who has had a similar problem to solve, than by any amount of written description. Most of the piping had been done by outside workmen, and at various times, each of whom seemed to have endeavored to get as much piping and as many fittings into his particular job as possible, without reference to the necessities of the case or to previous or future conditions. Consequently, the systems of piping for steam, water, gas, and the fire protection system of sprinkling, were in an almost hopeless tangle, and generally two or three times as much piping put up as was needed. The sprinkling system was really the only piping in the plant that was put up according to a regularly formulated plan, and was, of course, distinguishable by the constantly recurring sprinkler heads upon all the smaller overhead pipes. As a preliminary to revising this piping system (excepting the sprinkler system), a comprehensive plan was worked out and workmen regularly employed by the company began the changes in accordance with it. These changes were continued until the entire piping system (except the sprinkler pipes) was completed according to the plan. When this work was begun, a great deal of difficulty was experienced in tracing out the various lines of piping, and on one occasion when a plug was removed from a tee for the purpose of making an extension to the gas lighting system, a jet of water convinced the gas fitter that he was on the wrong line of piping. Several incidents (or accidents) of this kind led the writer to use distinctive colors to identify the different lines of piping. Accordingly, after considering the question thoroughly, he adopted the following system of colors.

Red: For sprinkler pipes and all water pipes connected to the fire pump and used for fire purposes.

Green: For all other water pipes.

Blue: For all gas piping.

Brown: For all heating coils and the piping leading to them.

Black: For all other steam pipes.

When the men started the work of painting the pipes, and the scheme became known around the plant, there were a great many free opinions expressed as to the sane condition of the superintendent's mind. There was much wagging of wise heads among "the old timers," and a good many jokes by the "smart Alecs," as to what kind of a scheme would happen next; but in a few weeks the novelty of the innovation wore off and the sober second thoughts of the makers of shop opinions brought about a realizing sense of the fitness of the scheme to the purposes for which it was intended, and like the scheme for distinctive colors for patterns, and for distinctive colors for cards, blanks, etc., the practical utility of the system was readily conceded.

In the years of practical experience since that time, each trial of the system of identification by means of distinctive colors has still further strengthened the opinion that it is a very valuable and practically useful scheme, and that there are an infinite number of uses to which it can be profitably put in the organization and routine systems of any manufacturing plant.

* * *

Some interesting particulars of gears made from a special composition termed "Unica," which appears to constitute a new departure in silent power transmission, are given in our European contemporaries. These gears are made principally from compressed cotton, and tests carried out at the Royal Testing Institute in Berlin show that their resistance to indentation is 45 per cent greater than German rawhide at 1,120 pounds pressure per square inch, and that they offer 100 per cent greater resistance to displacement than rawhide at maximum pressure. Other advantages of the gears are stated to be that they are not affected by oil, and are cheaper than other types of silent gears. They can be key-seated the same as ordinary metal gears without fear of failure, and without the necessity of using bushings. The ultimate breaking stress sustained by the teeth of gears made from this material was shown by the experiments to be 51 per cent over that of German rawhide pinions and 27 per cent above that of vulcanized fiber pinions. It is stated that in strength the gears equal cast iron gears.

* For previous article on color scheme for piping, see page 621, July, 1907, engineering edition.

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LATHE KINKS.

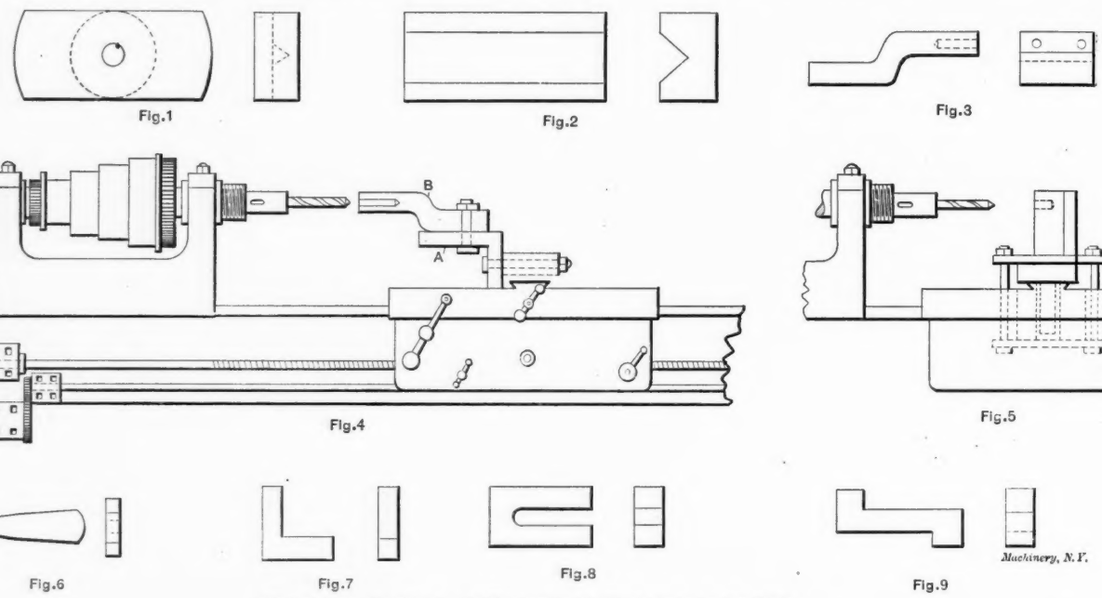
PAUL W. ABBOTT *

I once worked in a place where I was doing a medium grade of tool work, where there was no milling machine or drill press which I could use, so that it devolved upon me to do these two operations in the lathe the greater part of the time. Some of the schemes for doing this work, and the regular lathe work, will be presented in the following article.

The lathe used was a 16-inch Prentice with a first-class taper attachment, and it had the following equipment, the most of which I designed and made: One 12-inch three-jawed universal chuck, one 10-inch four-jawed combination chuck, and two drill chucks, one for rough use and the other kept for small, special jobs that necessitated a true running chuck. These chucks were mounted on hollow tool steel plugs, so that a bar of stock up to the capacity of the chuck could be run through and worked on. There was also one pair of special 60-degree cone centers used for nothing but the best work; one pair 60-degree cone cutters for ordinary work; one pair 90-degree cone centers (both hardened), used for rough, hurried work which I centered with a center punch; one long 60-degree cone center, projecting about 4 inches from the chuck, to be used on a piece of work that projected beyond the arbor or inside of a hole; two 60-degree half-cone centers for the tail-stock, one cut clear to center for squaring small work, and one cut down within 3/16 inch of center for heavier work; two pair 60-degree cone centers which were turned down; one pair to ½ inch and one pair to 5/16 inch diameter for getting inside of small holes; and one pair of centers for wood turning, of which I had a little now and then. As there was quite a little work on samples which were pointed 90 degrees, there was also a pair of 90-degree hollow centers, and three sizes of half-hollow centers for the tail-stock. Some of the work had round ends highly polished, and for that there was a steel center with a brass plug inserted in the end, which could be hand-tooled out to fit the work. All of the centers were draw-polished on the taper, and the head-stock centers were highly polished on the end that projected from center hole, while the tail-stock centers were left black. Thus they could be distinguished at a glance.

The collection of lathe tools consisted of about 300 of all kinds, shapes and sizes which were suitable for work ranging from 1/16 inch to 10 inches diameter. There was a set of Armstrong regular turners for holding high-speed steel bits, which I used altogether on regular turning. For drilling there were Nos. 1, 2, and 3 Morse sockets fitted to the lathe, and the following rigs: For regular plain drilling there was a plate, as shown in Fig. 1, which fitted the tail-stock spindle snugly, the work being supported by hand or blocked up on the bed of the lathe or carriage. For drilling round work, there was a V-block (Fig. 2), which was used with the plate shown in Fig. 1, the work being supported by hand. For drilling such jobs as shown in Fig. 3, or anything irregular in shape, an angle iron *A* was bolted on the side of the cross slide (Fig. 4), and the work *B* to be drilled strapped onto it. Any angle could be obtained in this way, and in drilling a row of holes it was particularly handy as the cross slide could be run along to first one hole and then the other. When drilling such work as a large box tool which was too large to mount on the angle iron, the cross slide was removed and the work strapped onto the ways of the cross slide as shown in Fig. 5. For drilling round work such as collars, I had a number of pieces of cold rolled steel of different diameters, from which one was selected to fit the hole in the collar, which was then drilled by using the V-block on the tail-stock spindle.

For milling jobs I had a number of arbors and a varied assortment of cutters. One of the best rigs, and one which no tool-maker should be without, was a 9-inch slitting saw, 1/16 inch thick, which was kept mounted on an arbor all the time with the dog on the arbor, ready to put in the lathe at a minute's notice. Another useful fixture consisted of a flat block of cast iron about 6 inches long, 4 inches wide, and 1½ inch thick, having two 90-degree V's in it at right angles to each other, and a number of tapped holes. This block, which was bolted to the top of the cross slide, and moved with it, was put to numberless uses. If I wanted a flat handle, such as shown in Fig. 6, did I wait for a forging? Not I!—simply reached under the bench and dug out a piece of soft steel the right thickness, laid off the right shape on it, strapped it to the block, and sawed it out to shape; the whole operation taking about five minutes. The saw ran at approximately 200 feet per minute (it had fine teeth, about 14 to the inch), and it was fed through a ⅜-inch flat stock at the rate of 2 inches per minute. If I wanted to cut off a piece of bar stock, I never went to the shaper to do it; I could saw a piece off with this rig while I was getting the shaper ready. A few of the pieces for which this rig was used are shown in Figs. 7, 8 and 9. If a number of pieces were to be cut from the bar it was strapped down loosely in the V-groove, and a stop put on the outside of the block to bring the pieces all the same length. The carriage was then locked and the pieces sawed. One inch cold rolled stock could be cut off at the rate of one piece per minute. Lard oil was used as a lubricant. When cutting brass the saw ran at 500 feet per minute. For milling such jobs as the heads of special cap-screws or squared ends on drill chuck wrenches, the rig shown in Fig. 10, which was mounted on the cross slide, was used. For this fixture there was a set of cast-iron bushings with holes varying by sixteenths of an inch for different sizes of work. I used to



Figs. 1 to 9. Tools for, and Examples of, Work done on the Lathe.

* 18 Waterford Street, Lowell, Mass.

have some bushings to make, similar to the one shown at *C*, which had to be cut into four equal parts. For doing this job there was a squared bushing *D* and the arbor *E*. The squared bushing was inserted in the body of the fixture in place of the round one; the square headed set-screws removed, and a thumb-screw having a flat end put in. The arbor *E* was inserted in the squared bushing, and the screw tightened down on it. The bushing to be slit was slipped onto the arbor, and the counterbored washer *F* tightened against the end. The jig was blocked up to such a height that the arbor *E*, where the bushing went on, just touched the saw, passing underneath it, the saw running backward. The flat sides on the bushing *D* served as an index for the four cuts as the thumb-screw was tightened down on each side. Split collets were also sawed in this jig, and short end mills and countersinks were fluted with it. Such a job as milling the face of

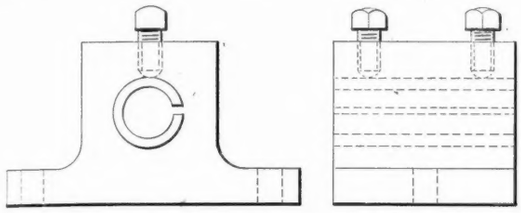


Fig.10

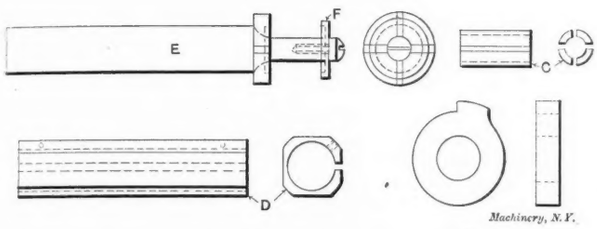


Fig.11

Figs. 10 and 11. Fixture for Milling on the Lathe and Examples of Work.

the small cam, shown in Fig. 11, was done by strapping the V-block (Fig. 2) on the cross slide with the V lengthwise of the lathe, and strapping the arbor, holding the cam in the V so the arbor could be turned with a wrench on the end. Then with an end mill held in the drill chuck, and getting the proper depth of cut by feeding in the cross slide, which when in far enough was locked, the arbor was revolved and the piece milled to the shape required, except the sharp corner, which was afterward filed.

For boring jobs I had the universal and combination chucks, a 16-inch face-plate, and a 6-inch four-jawed, independent, reversible-jaw chuck for small eccentric work, and a 4 x 6-inch angle iron. Some of my boring jobs were as small as ⅛-inch diameter, and others as large as 10 inches diameter. The boring on the angle iron was of the usual nature—boxes, bearings, etc., for repairs on machines. When pieces were too large for the face-plate they were strapped to the carriage and a boring bar used. When boring holes in the ends of long shafts, the angle iron was mounted on the side of the cross slide as in drilling, and the shaft was strapped in the V-groove in the angle iron. A drill was first used, and then a small boring tool which was held in the drill chuck. The boring tool is shown in Fig. 12. This feature of having 90-degree V's planed in the angle iron is a valuable one where there is any round work handled on the angle iron.

In connection with the cutting of small pitch threads, I always used carborundum slip stones to resharpen the thread tool before taking the final finishing cuts; in this way it was not necessary to remove the tool and disturb its setting. Slip stones of a medium grade of coarseness will remove 0.002 or 0.003 inch from a small surface in no time. These were also used on repair work. When reaming odd size holes, if the reamer was cutting a little large it could be stoned 0.002 inch under size in two minutes. For straight lathe work I had a number of features for facilitating the speed at which it could be done. There were three rests for the lathe: the regular center rest, a follow rest, and a rest for light work (Fig. 13) which fastened to the tail-stock spindle. For the center rest I had five sets of jaws; one set for small work down to 3/16 inch diameter; one set of shorter jaws for the usual run of work; one set still shorter for work up to the full capacity of the rest; one set of jaws that were tapered off to 3/16 inch square on their ends, for taper work; one set of steel jaws 5/16 inch thick to go in between shoulders or other narrow places. Thus there were sets of jaws for all the work that came along, and there was no waiting to file jaws to take in a large piece of work and then find them too short for the next small work that came. The slots in the rest were numbered and the jaws were numbered to correspond, so that the latter always lined up correctly. On the jaws a center line was marked so that as they wore away and had to be filed off on the sides to make them narrower on their points, they could be filed to the center line and always be lined up with the center line of the lathe. The follow rest, which was of the usual type, had several sets of jaws for different sizes of work. The rest shown in Fig. 13 is not very common, but is mighty handy on small work. The arms *G* are adjustable on the shaft, and the jaws *H* are of brass and are also adjustable.

The feed on this lathe was thrown in by a T-handle *J* which could be turned either way, and also thrown out by revolving in the same direction. When turning a long piece in the lathe a bar was fastened to the bed of the lathe, as shown in Fig. 14, and in that an adjustable rod *K* which, when the feed handle struck it, would throw the feed out. This was very handy, as I could be doing something else while turning a long piece.

I used to have a number of long, square threaded screws of mild steel to make 1⅜ inch diameter, three threads per inch. When doing square threading an Armstrong tool-holder was used for holding ⅜-inch square tool bits; these bits were made of Novo steel. There was one tool for roughing and one for finishing, 0.005 inch being left on each side of the thread to remove with the finishing tool.

As there was no compound rest for the lathe, when doing angular work other means had to be provided. For angles up to 10 degrees, measured from a line at right angles to the ways, setting the tail-stock over would do. For angles up to 15 degrees, measured from a line parallel to the ways, the taper attachment was used, but for angles of larger degree, another scheme was adopted. The carriage feed and the cross feed could both be thrown in together, which gave an angle of about 45 degrees. This angle could be varied either

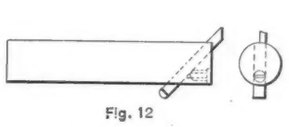


Fig. 12

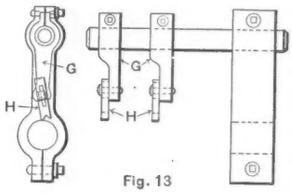


Fig. 13

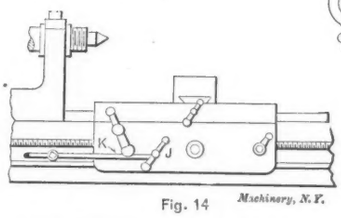


Fig. 14

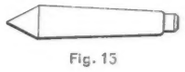


Fig. 15

Machinery, N.Y.

Figs. 12 to 15. Automatic Feed Stop and Miscellaneous Lathe Tools.

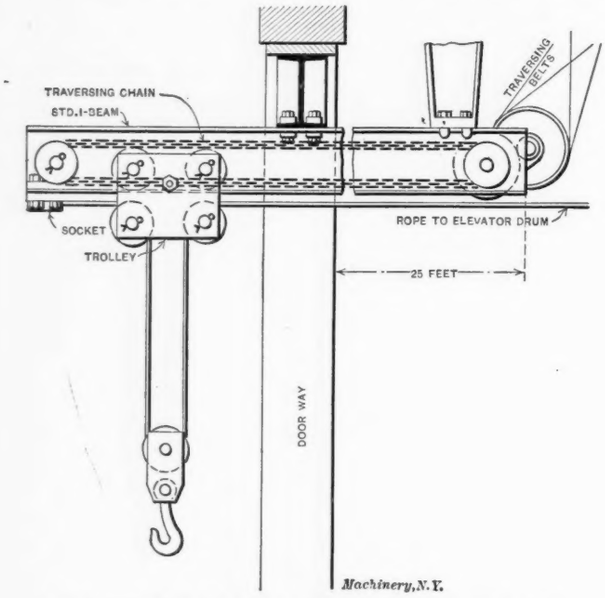
way by setting the tail-stock over or by connecting up the taper attachment. This was applied in a very practical manner to the making of some 90-degree inserted tooth countersinks, 5 inches in diameter. I used this method for turning the 90-degree nose of the countersink, and boring the 90-degree steel cone which fitted the nose, which was afterward cut up into sections for holding the teeth. Having no indexing attachment on the shaper, the graduating was all done in the lathe with the gearing, using a sharp-pointed tool in the tool-post, and then transferring the work to the shaper and working to the lines. When cutting off a piece on an arbor, I always set my calipers to about 0.005 inch over the size of the arbor, and then, holding the calipers in the slot made by the cutting-off tool, cut away freely until the calipers slipped over the work. This is only a little kink, but it often saves cutting into the arbor. There are various ways of fix-

ing the ends of centers, but the best way I know of is shown in Fig. 15. A center finished like this will stand any amount of banging without injuring the fit in the center hole. Some of these kinks may not be new to all, but they are all good ones, and time-savers.

* * *

A CONVENIENT OUTSIDE SHOP HOIST.

The shop of E. E. Bartlett, of Boston, the builder of the Greenerd arbor press, is located on the sixth floor of a factory building. As the elevator service is not particularly convenient, and as the castings for the larger sizes of the arbor presses are quite heavy, they are hoisted up the outside of the building and in through a door onto the floor of the shop. The same arrangement is used for lowering the finished work. This is a very common practice. The ordinary rig consists of a wooden beam projecting over the doorway for a few feet and provided with an eye-bolt to which a block and tackle is rigged, which is operated by anything that comes handy.



A Convenient Hoist for Handling Material through an Outside Doorway in an Upper Floor.

For hoisting a bale of hay with such an arrangement to the second story of a stable, a horse is hitched to the end of the rope; in manufacturing establishments the horse is sometimes used, but the hauling is more often done with some homemade winding arrangement.

Mr. Bartlett has improved on the primitive construction in a way that gives him little reason to regret the inefficiency of the elevator. The arrangement is shown diagrammatically in the accompanying line engraving. A steel I-beam, properly proportioned, is firmly suspended beneath the arch of the door-way, projecting outdoors for a sufficient distance to allow the material to clear the sides of the building, and extending inward for 25 feet or so over a shipping and receiving floor. On the under flanges of this I-beam runs a trolley, provided with two idler sheaves. Over these passes a wire rope, from which, by means of a block and hook, the load is suspended as shown. The outer end of this rope is fastened to the outer end of the I-beam, while the inner end is led back to a regular commercial form of elevator hoist provided with the usual stops to prevent overwinding, and having the usual arrangement of shifting belts for raising or lowering the load as required. The controlling ropes for this elevator hoist are brought to a point near a window beside the doorway, where the operator can have a full view of the operation, both indoors and cut.

The trolley is connected with a chain running over the idler at the outer end of the beam and over a sprocket at the inner end. This sprocket is connected by gearing with tight and loose reversing pulleys, whose belt shifter is operated by cords which are also led to the operator's position by the window. It will be seen that with this familiar arrangement of trolley and hoisting rope, the load may be raised or lowered and traversed, together or separately, the two motions being independent of each other. The operator at the window raises the load from the truck below until it reaches the level of the doorway, then runs the trolley in by power until it reaches the desired position over the receiving floor, when it is lowered and released. One great advantage of this arrangement, from the standpoint of safety, is the avoiding of the necessity for leaning out through the door to pull the load in; a frequent cause of accidents is thus avoided. Another advantage is the convenience, in shipping, of being able to take work from the floor and deposit it in the wagon, without requiring the intermediate operation of shifting on rollers into the elevator, and from the elevator to the truck. The whole arrangement is very simple, and may be made almost entirely from commercial parts. For hoisting loose castings a basket is used, made of boiler iron.

* * *

EXPERIMENTS WITH ROPE AND BELT DRIVES.

Some experiments have been undertaken by the Technical Institute at Charlottenburg, Germany, in order to establish definitely the loss of energy in transmitting power by means of belts and ropes. These experiments indicate that the capacity of belts for transmitting power at high velocity is considerably higher than given by ordinary formulas and calculating methods. It appears from the experiments that it is an advantage in belt drives to use large pulley diameters, and consequently high peripheral velocity. Considerably better results are obtained if the pulleys are made from wood for diameters less than 24 inches. An idler for obtaining the required tension, placed close to the small pulley and having a diameter at least 50 per cent greater than this pulley, does not reduce the efficiency of the drive in any appreciable degree when the belt speed is not greater than 100 feet per second. An idler for producing proper tension and for providing larger angle of contact on the smaller pulley is therefore to be recommended in belt drives of high ratio between the sizes of the pulleys.

The friction in the bearings is considerably greater for rope drives than for belt drives, because ropes must be under higher tension than belts, all other conditions being equal. The efficiency of rope drives decreases considerably for high speeds, while it increases for belt drives. When high peripheral velocity is required it is therefore advisable to use belts rather than ropes. In the case of rope drives the efficiency is also reduced when the diameter of the pulley or sheave is reduced, due to the power required for bending the rope, whereas the diameter of pulley in belt drives is of very little consequence, within rather large limits. The highest efficiency obtained during the tests referred to was 98 per cent with the belt drive, all conditions being ideal. Power transmission by means of a single rope, gave 97 per cent as the highest efficiency; using two ropes side by side, made the highest efficiency 95 per cent; and only 90 per cent efficiency was obtained with four ropes side by side. The efficiency in the case of rope drives thus decreases about in proportion to the number of ropes employed. The figures quoted give the actual efficiency of the drive, the friction losses in the bearings being subtracted. The latter are also greater in the case of ropes than in the case of belts, due to the higher tension required in rope drives. While idlers in the case of belt drives did not appreciably decrease the efficiency, in the case of rope drives it was found that idler sheaves decreased the efficiency considerably.

* * *

A scheme for securing efficient industrial education which undoubtedly could, in a modified form, be worked to advantage in many of our industrial centers in the United States, has been adopted by a number of English firms. It appears that some municipalities maintain public evening schools especially adapted to the needs of apprentices, but as the expenses for these evening schools are rather too high to be borne directly by the municipality, if efficient instruction is to be given, the local firms have agreed to pay a certain sum for the instruction of each of their respective apprentices who joins an evening class, and monthly reports are forwarded the firms as to the attendance and progress of the students.

THE MANUFACTURE OF TAPS—2.

In the January issue, the turning, threading, squaring, fluting, chamfering, and relieving of taps, as practiced in the manufacture of these tools by the Wells Bros. Co., Greenfield, Mass., was treated in detail. It is proposed in the present and concluding article on the manufacture of taps to treat of the hardening and other operations still remaining to be performed on the taps, and also to refer briefly to some of the many interesting features of the shop equipment and systems used in the works of the Wells Bros. Co.

Hardening.

The hardening of taps and dies in this plant is carried on according to the most modern methods, and several features have been introduced which are of particular interest. The hardening room is completely dark except for what little daylight comes in through the ventilators in the ceiling. There is an advantage in having this room dark as it is possible for the hardener to judge exactly the heat of the pieces to be hardened, by their color. It would seem that a

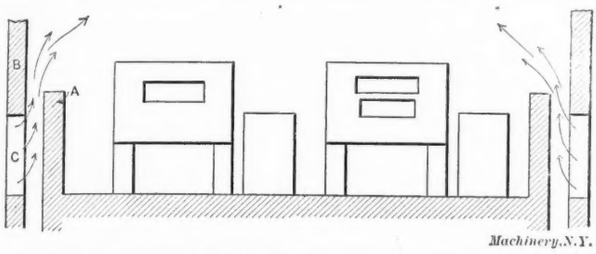


Fig. 20. Diagrammatical Sketch of Arrangement of Hardening Room.

hardening room without windows would be rather uncomfortable, but the ventilation is of the best, and the arrangement for securing efficient ventilation without letting in the light is indicated diagrammatically in Fig. 20. The hardening room proper may be said to consist of a concrete tank *A* having walls extending up about 3 feet from the floor. Outside of these walls are the actual outside walls *B* of the building, which are provided with openings or windows *C* below the level of the top of the walls *A*. From these windows the air circulates through the room, escaping through ventilators in the ceiling.

This system of ventilation evidently is unusually efficient, as the hardening room was much cooler than a great many others which the writer has known, in which the windows for ventilation and light were provided directly in the walls. It is evident that it is permissible to have the windows constantly open and secure better ventilation in a case where the arrangement is as indicated in Fig. 20, because the cold air does not strike the furnace directly, nor does the draft inconvenience the operators, as is often the case when ordinary windows in a hardening room are opened.

The furnaces, which are of the company's own design, are heated by oil fuel. An underground tank is provided outside of the works, having a capacity of 6,000 gallons. From this the oil is pumped to a small tank where it is under pressure and from where it goes to the various furnaces. The surplus oil returns to the big tank by a return pipe. All piping is under the concrete floor in the hardening room. There are two regular hardening furnaces installed in the works, one for large and one for small work. No lead pots filled with molten lead are used for ordinary hardening, as it is considered that the method of hardening in lead is a poor one, and that in order to obtain satisfactory results more modern methods must be employed. The hardening furnace for small work is provided with ten tubes or pipes 1½ inch in diameter and 14 inches long. These tubes pass directly through the furnace and the outside walls of the furnace frame, and are open at the front end. The flames from the burners strike the outside of that part of these tubes which is inside the furnace. The pipe used is ordinary gas pipe, and burns out in from four to six weeks.

The work is placed in half circular shells and pushed into the tubes where it is heated slowly and very uniformly. The operator observes when the work has reached the correct hardening temperature, then he removes the half circular shell with the work from the tube, and dumps it directly into the hardening bath which consists of ordinary brine. It has been found that this method of hardening is superior to any that has been tried in the works, and that the taps come out of the hardening bath with a remarkably even texture. Taps up to five-eighths inch diameter are hardened in this manner.

Larger taps are hardened in a furnace where the oil fuel strikes cast iron plates on which the work rests. The work is heated very slowly. By distributing the flame from the burner in a certain way, it is possible to heat the furnace and the cast iron plate at one end much more than at the other. The work is first put in at the cooler end of the furnace, and gradually moved over to the hottest part, and when it has been in long enough to insure a uniform heat throughout the work, even on large pieces, it is removed and quenched, as usual.

Some taps, like bit brace taps, for instance, are not turned up from the solid stock but are drop forged. These drop forgings must be annealed before the taps are turned to the correct size. The annealing is done in an ordinary annealing furnace, the work being packed with cast iron chips in cast iron boxes and a cover of cast iron placed on the boxes. These boxes are placed in the furnace in the morning and the fire is kept going for ten hours. The boxes are then removed from the furnace the next morning.

Some interesting things seen in the hardening room which do not have direct bearing on the manufacture of taps, may here be mentioned. One is the method for obtaining the mottled effect which the company produces on die-stocks and several other tools having large polished surfaces. In order to obtain a fine mottled effect on the steel, the object to be treated is first highly polished and then very carefully cleaned from all oil in hot soda solution. It is then slowly heated to a temperature of from 150 to 200 degrees by placing it on the hot fire-brick covering the top of the furnace. When heated to the degree mentioned, the steel is put in a pot of heated cyanide of potassium and brought to a dark red heat. It is then dipped into clear water and vigorously moved about in this. Unless the work is moved about when cooling off in the water, the mottled effect desired will not be obtained.

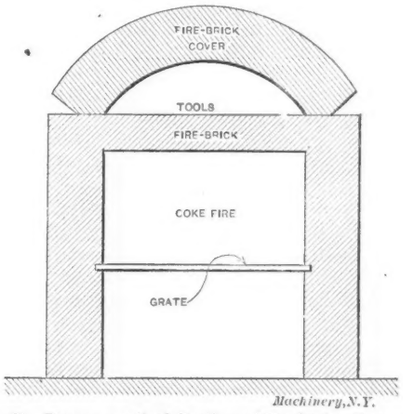


Fig. 21. Diagrammatical Section of Hardening Furnace for High-speed Steel.

Gages are not hardened by heating in the furnace the same as regular tools, but are pack hardened. The gages to be hardened are packed in ordinary ground bone in cast iron boxes covered with fire clay on top, and then heated for about three hours.

For hardening high-speed steel, a special furnace, shown diagrammatically in Fig. 21, is employed. For obtaining the heat required, coke and an air blast are employed. Small work is heated from three to four minutes and quenched in linseed oil mixed with ordinary salt; as much salt as the oil will dissolve is used.

Long taps which require straightening are heated to a straw temper and then placed under a straightening press having two cast iron blocks in which the tap rests at the ends. A screw with a block bearing on the tap is then used for obtaining the required pressure for straightening the tap. All taps are tempered in oil, and the temper is drawn to a temperature of from 430 to 450 degrees F.

Polishing the Taps.

Before hardening, the shank of the tap is polished. After hardening, the taps are again returned to the polishing room when they are ground or polished in the flutes by means of a small vulcanized wheel of semi-circular cross-section. The taps are then burred between the threads with a piece of soft steel, usually hoop iron, which is caused by hand to slide or rub between the teeth, the tap meanwhile being revolved on centers. After this burring operation the taps are cleaned in the threads by a wire brush revolving at high speed. Then the shank and the end and corners of the square are polished by hand.

A view of the polishing room is shown in Fig. 22. All polishing and grinding is done by hand; the polishing room

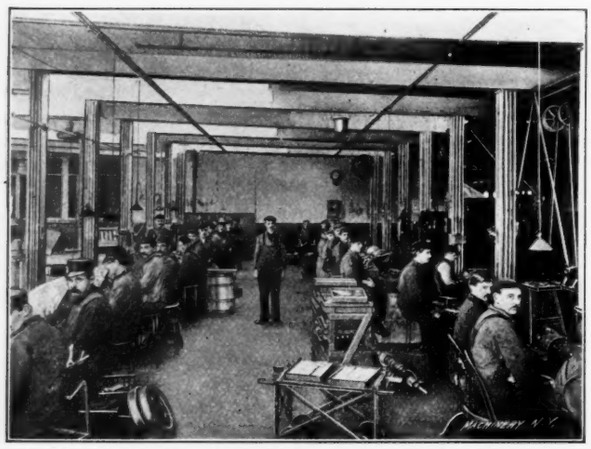


Fig. 22. Grinding Department—A Common Form of Shop Truck used in the Shops is shown in the Foreground.

is unusually free from dust owing to the fact that every wheel is provided with a sheet-steel hood connecting with an exhaust system under the floor. The arrangement is shown plainly in Fig. 23, which also shows a machine of rather ancient design, it having been built in 1877. The most interesting thing about this machine is that it is provided simply with ordinary cast iron boxes carefully protected from dust by dust caps, and while it has been in constant use for the last thirty-two years, the boxes are still in good condition. This indicates the possibilities of regular cast iron boxes for journals running at high-speed, provided the boxes are carefully protected from grit and dust.

Tools for Inspecting the Taps.

The taps are now ready for the inspection department, a view of which is shown in Fig. 24. It should be mentioned in this connection, however, that between each operation of any consequence all tools go to the inspection department to be inspected before the next operation on the tools is performed. In the inspection department the system of gages developed by the Wells Brcs. Co., examples of which are shown in Figs. 19 (January issue) and 25, play an important part. Fig. 25 shows two thread micrometer gages for measuring the angle diameters of taps; these micrometers are provided with large dials at the measuring screw end of the device, the dials being graduated so that 0.0001 inch can be easily read off, this amount being equivalent to 3/64 inch on the periphery of the dial. These thread micrometers are made according to the principle developed by the company, having the two measuring points offset half of the pitch so that each point enters directly into a thread in the tap to be measured. In the foreground is shown a block holding a number of measuring points which can be substituted in these measuring instruments for different pitches and classes of threads.

On the right-hand side in Fig. 25 are shown two thread micrometers mounted in convenient holders, which are provided with points for measuring the angle diameters of threads, the anvil point being adjustable for different pitches, the same as in the larger instruments. In the same illustration is also shown an interesting gage for measuring the angle and width of the flat of Acme standard thread tools. In Fig. 19 are shown the regular working gages employed in the works and in the inspection room. We have already referred to the limit gages *A* and *B* for measuring diameters of plain work. It will be seen that these gages are also made with sharp points, as shown at *C*, for measuring the angle diameter of threads. This system of gages, as well as some of those shown in Fig. 25, has previously been described in MACHINERY in the August and September, 1907, issues. For measuring the lead, gages as shown at *D*, Fig. 19, are used.

The company is at the present time preparing to place on the market a system of limit gages which have been used in the works for some time, of which one example is shown at *E*, Fig. 19, the female gages being placed in the box shown, and the male gages being seen in front of the box. The feature of these gages is that each gage is surrounded by a hard rubber ring on the outside, one being black and one being red. The black color indicates the maximum limit gage and the red color the minimum gage, the red color being the "danger signal." This same indicating system is followed in regard to the handles of the plug gages. The advantage of such visible indications of the maximum and minimum gage, which obviate the necessity of looking for the stamping on the gages, is evident.

The system of setting the limit gages of the type shown at *C*, Fig. 19, is of considerable interest. In order to make it possible to set the gages easily to any predetermined limits, a special threaded plug is provided, having a very slight taper. At a certain place on this plug the exact standard size is indicated by a line. The taper for each plug is so selected that the next thread below the size line marked is 0.001 inch less in diameter than the standard diameter at the line, the second thread, 0.002 inch less, and so forth; the first thread above the size line is, of course, 0.001 inch larger in diameter than this dimension. By adjusting the maximum and minimum limits of the gages to this taper plug, the gages can evidently be set to any limits varying by 0.001 inch, and if special care is used, limits as close as 0.0005 may be ob-

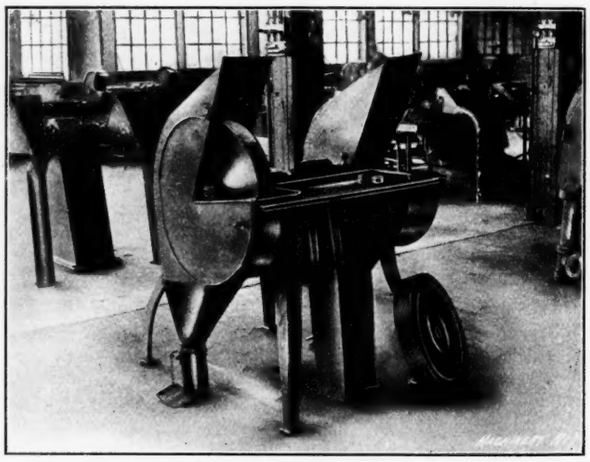


Fig. 23. An Old Grinder built in 1877 which still gives Efficient Service. Note also System used for Exhausting the Dust due to Grinding.

tained. The same system, of course, can also be used for the setting of the plain limit gages *A* and *B* in Fig. 19, a plain plug with size lines being used.

The Stock Room.

After the inspection the taps go into the stock-room, where the smaller ones are put away in drawers, as shown in the foreground of Fig. 26. The larger taps are put away on open shelves. All the racks and shelves are made of metal, and the shelves are adjustable for height on principles similar to those employed in adjustable shelve bookcases. This gives great flexibility to the storage system. The stock-room is also unusually light, due to the fact that there are no solid partitions such as are necessary when the shelves are made from wood. On each of the drawers in which the smaller taps are contained, the kind, size, and pitch of the tap is marked, and also the minimum and maximum number of taps which ought to be kept in stock. When the storekeeper finds that the number of taps of a certain kind is running down towards the minimum limit, he puts in an order for a new supply of

this kind of taps. In this way a full supply of all sizes and pitches are assured without any elaborate system of bookkeeping.

Some Features of Interest in the Shop.

There are many features in the shop equipment and the systems employed, which are seldom seen in other plants. One of the first things which the observer will notice is the liberal use made of concrete. Not only are the floor in the shop and the larger machine foundations made of concrete, but many smaller machines are provided with concrete supports instead of cast iron legs, and it is stated that the cost of concrete used for this purpose is only from one-fourth to one-fifth that of iron legs. Concrete is also used largely for supports for work benches, and in the shipping room the writer saw a large bench made entirely out of concrete, intended to be used for nailing boxes; the noise commonly present in the shipping room, due to the hammer blows in nailing boxes and crates and the vibrations in the benches and floors, are largely eliminated in this shipping room, due to the fact that there are no vibrations in the supporting bench or floor, and it appears from a comparison with other places within the writer's experience that the larger proportion of the noise is due not to the nailing operation itself, but to the fact that the box or crate is supported on a flimsy and vibrating support.

All tools are stored in the shop in cabinets with sliding glass doors, and the benches in front of these cabinets are

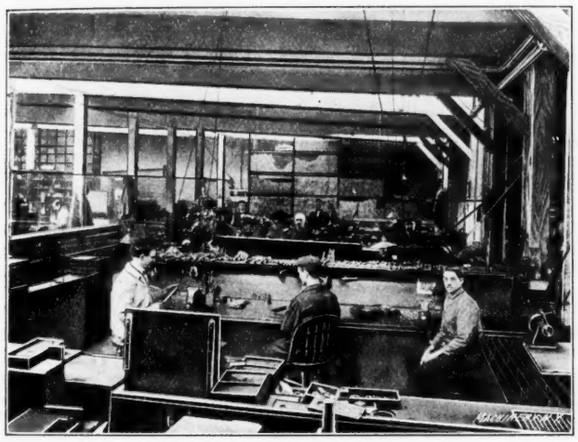


Fig. 24. Inspection Department.

covered with linoleum. It has been found that it is not only cheaper to keep the benches thus covered, if a neat appearance is valued, than it would be to try to keep a wooden bench in fairly good condition, but it is also much easier to keep clean. All cutters are placed on wooden pegs mounted in blocks, and on the end of each block is given the sizes of the cutters and the purpose for which they are intended.

Each foreman in the shop is supplied wtih a volume of blueprints bound in a loose leaf binder, and he is also provided with a loose leaf binder for all special instructions given to his department from the superintendent's office. All gages are turned in to the inspection department once a week to be inspected and adjusted.

Besides the regular stock-room, a storeroom is also provided for work in progress. All work goes to this storeroom between each operation, and as mentioned before, it is then inspected if the operation warrants this. On regular taps only the threading and finishing is inspected, there being practically no chance for mistakes in the other operations inasmuch as the operators are provided with limit gages which determine whether the work is made as required. One of the features in the shop which saves a large amount of handling of the material, and makes its transportation from one part of the shop to another convenient, is the use of box trucks of the type shown in Fig. 27. This truck is practically an iron truck provided with a wood lining, and it rests on four wheels, one at each end and one on each side, as shown. When the work has been placed in the truck after having been finished in one department, it is transported to the storeroom for unfinished work, and remains in the truck until it is sent to the department where the next operation is to be performed. It is then taken out of the truck as it is wanted for the machines, and when the operation is performed it is placed in another truck ready to go back to the storeroom again; in this way any superfluous amount of handling the material is avoided. These box trucks at the same time provide good means for storage of the articles.

In the same illustration is also shown one of the very convenient benches used all over the shop. It will be noticed that it consists mainly of an iron frame provided with two wooden shelves. All over the shop one finds trucks and stands of various types built up with iron frames, Mr. Wells being a

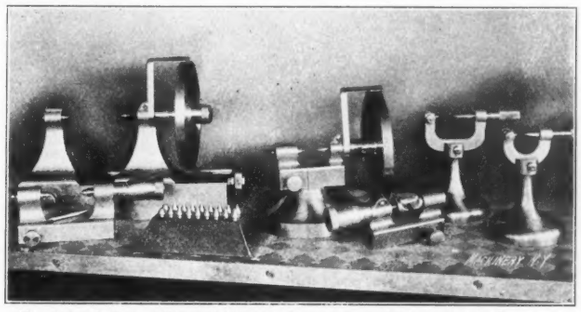


Fig. 25. A Set of Thread Micrometer Gages of the Wells Bros. Co.'s Type, used in Inspecting Taps.

great believer in "iron furniture" on account of its strength and durability. The interesting feature about this work bench, however, is that it has no sliding drawers, but is provided with two cast iron semi-circular trays which are mounted on a stud at the center of the circle, and when the material contained in the trays is wanted, all that is required is to swing the tray out so that the contents are exposed. It is clear that in this way the whole contents of the tray will become visible when the tray is swung out completely, whereas in the case of a drawer, it is not usually possible to pull it out far enough to see the complete contents, particularly when heavy tools are stored away in it. Besides, the difficulty of trying to pull out a drawer containing heavy tools and making it slide freely is well known. In the engraving, Fig. 27, the upper tray is shown closed, while the lower one is shown swung out so that about three-quarters of the contents are exposed to view.

The equipment in the shop is highly specialized. In a general way one might say that there are very few standard machine tools, and there are few machines of modern make. This, however, in no way interferes with the efficiency of the

Fig. 26. A "Street" in the Stock-room where the Finished Work is Stored.

shop, for it is plainly in evidence that a simple machine designed exclusively for performing one specific operation is a far better investment, and far more efficient for the work it is intended to do in specialized manufacture, than would be one of the modern universal machines which in many respects are largely tool-room machines. It is Mr. Wells' opinion that in most classes of manufacture the highest efficiency can be reached by simple improvements of the ordinary design of machine tools rather than by departing too far from the old line of tools and trying to introduce new features which

are seldom or never required in ordinary manufacture. There are many machines in the shop which were built twenty or more years ago which are still in use and which perform the work they are used upon fully as efficiently as would a standard modern machine tool, but it is understood that these conditions are true only in cases where the manufacture is highly specialized as in the case of making taps and dies.

Being a one-story shop and provided with skylights, it is exceptionally well lighted, a feature which is also evidenced

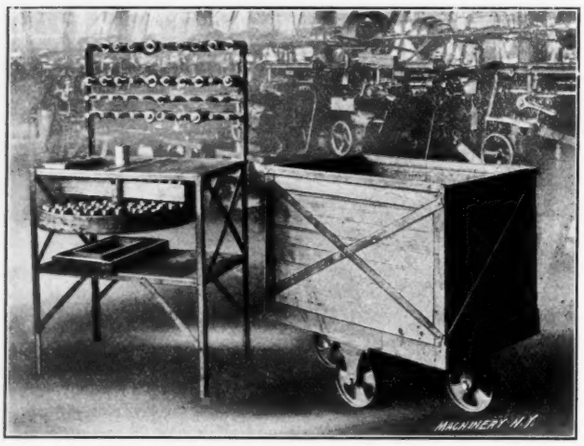


Fig. 27. A Work Bench with Handy "Drawers" and a Storage Truck used Extensively in the Shops.

by the appearance of the half-tones, the photographs for which were taken on a very dark and foggy day with no direct sunlight whatever.

After having noted the methods at present employed in the making of taps in a highly specialized tap manufacturing plant, it may be interesting to refer to the methods which Mr. Wells and his brother first employed when they started in making taps thirty-three years ago. Special machinery, and even the now common types of standard machines, were then not as common as now, and when manufacturing on a small scale in particular, some methods which to-day would be considered rather crude, were employed. Mr. Wells tells of how they used to cut off the tap blanks in the blacksmith shop from the rough stock, one man wielding the sledge while another held the cold chisel. The threading was all done in ordinary lathes with chasers, Mr. Wells being the first man

Fig. 28. Office of the Wells Bros. Co.

who employed chasers for thread cutting at the Wiley & Russel Co.'s Works in Greenfield in 1874. The fluting at that time was done in a small milling machine where one tap was fluted at a time, one man being required for each machine to feed the table by hand. At first the tempering of the taps was done in an oil stove. Little by little, as the shop grew, these methods were superseded by more efficient ones, until at the present time the manufacture is placed on the efficient basis outlined by the present description of the plant and the methods.

HOW TO GET A JOB.

A. P. PRESS.

Well, the hard times have come and gone again and the boys are out hunting for jobs. Now, there is a lot of difference between getting a job and holding it. Some fellows are natural job-getters, and others are job-keepers; and when the job-keeper really loses his job, he is "up against it for fair." I have done lots of job hunting, and I have had the jobs hunting for me; and there is a big difference between the two kinds of sport.

In most of the big factories, nowadays, the hiring and sacking is done by a hiring clerk, who doesn't know a tool-maker from a power-press hand. When the foreman of a department wants half a dozen men he orders them the same as he would the same number of files from the stock-room, and after he gets them he sorts them out, keeps what he wants, and lets the rest go. Now, this is all very well for the shop, but it's kind of hard on the fellow who is doing the hunting. And so a few words to him may help him bag his game:

First, be sure what you can do and do *well*. Go after a job in that line, and if it is not there, take the next place. If a man comes to me and tells me he knows how to break stone, and that he can break them quickly, then I have some encouragement to try him, for the man that can do one thing well can learn to do another well, provided it is in his capacity to do it at all. Don't tell me that you can do anything, for of all answers to an inquiry as to what a man can do, that's the most discouraging; in fact, it isn't any use to talk with the applicant further.

Second, don't run in a hard-luck story about your wife and seven small children, because if the boss is "onto his job" it won't help your case a mite; he isn't running a free soup house but he is trying to "deliver the goods" and not have the freight charges too high. If you are hard up, he may give you a dollar, but he won't give you a job.

When you want a job just ask the boss flat if he wants a good vise hand, or whatever your "best hold" is; tell him what pay you want, and that you will go in and work and work quickly, and if you are not worth the price to just drop you and there will be no hard feelings. If he has a job to give you can get it.

Third, if you are an old fellow and wear glasses, put them on before you go in; then you won't feel "streaked" when you get on the job and have to wear them. I well remember the last job that I went for; I heard the boss coming up the corridor and I put them on in a hurry. He came in, talked a minute and said he was looking for a man with plenty of experience and asked if I would go on as foreman. Well, I guessed I would, and I did and made good.

Now, a word about cheek—not gall—just cheek. The boss saw a new man sweeping up the shop, so he said: "When did you come in?" "Yesterday, sor." "Who hired you?" "The man over there, sor," said the sweeper, pointing to the other sweeper down at the end of the room. "Well, how's this, Tom?" said the "super," calling up the old hand. "Well, sor, had more work than I could do, and so I put him on." "Well, I'll be d—," said the super, but he went into the office and had a good laugh over it and ended by putting him on the books.

Lately, the graft mania that we have had for the last few years has had its effect in some of the shops, and there has been a lot of what I would call "foreman grafting" done—mostly in the big shops. The foreman will charge a man, say, $5 for his job, and then collect it on the installment plan. There is one thing worse than to give a man a dollar for a job, and that is to take it, for the moment that you do that you put yourself in the other man's power. The case to which I refer came up lately; the man paid his $5, came in and worked a few days, and then, not liking it, went to the office and stated the case and wanted to know whether, if he got through, he could get his $5 back again. There was "something doing" right away.

* * *

According to the *Brass World*, the best spring metals (alloys) are those which do not contain zinc. When zinc is present crystallization is more apt to occur.

JIGS AND FIXTURES—11.

EXAMPLES OF BORING JIGS.

EINAR MORIN *

In the January issue of MACHINERY the fundamental principles of boring jigs were outlined. In the present installment a number of applications of these principles to boring jigs that have been designed for shop use will be shown.

In Fig. 126 are shown two views of a small jig supported directly on the work to be bored. This jig is used for boring out a cross-slide carriage, and is located on the work by the dove-tail slide and held in place by the two set-screws *A*. The two bushings *B* are driven into the solid part of the jig and the two corresponding bushings *C* are placed in the loose leaf *D* which is removed when the jig is placed in position on, or removed from, the work. The two set-screws *A* do not bear directly on the side of the carriage but are provided

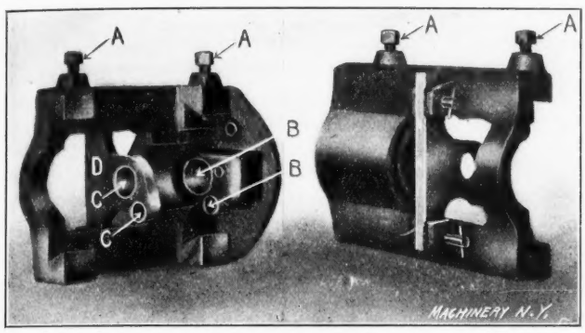


Fig. 126. Example of Small Boring Jig, with Removable Leaf for Holding Guiding Bushings.

with brass or steel shoes as shown in Fig. 130, where *E* is the shoe. The leaf *D* cannot be attached permanently to the jig and simply swung out of the way when the jig is located on the work, because it could not be swung in place after the jig is applied on account of the small clearance in the cross-slide carriage. The leaf is therefore made loose, which is an objectionable feature, but lugs have been carried up on the casting on both sides of the leaf as shown, to give good support; these lugs are carefully finished to fit the leaf, and the latter is located and held in place by ground plugs.

In Fig. 127 is shown a boring jig which receives the work *A* between two uprights. The work in this case is the tail-stock of a lathe where two holes *B* and *C* are to be bored

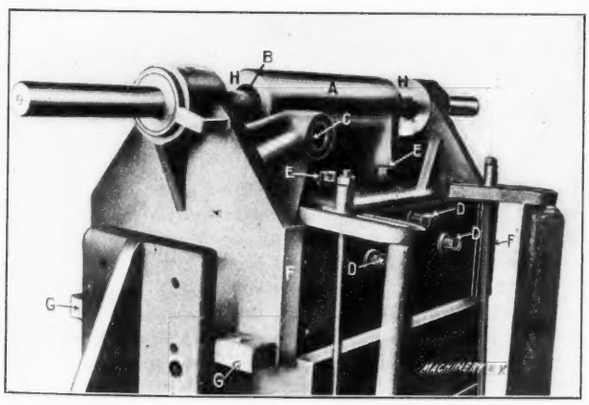


Fig. 127. Common Type of Medium Size Boring Jig.

out. The bottom surface of the tail-stock is finished before boring, and is located on the finished bottom of the jig by means of a key and keyway. The keyway is cut in the jig and is a little wider than the key in the work, and the set-screws *D* bring the key against one side of the keyway, that side being in accurate relation to the hole *B* to be bored in the tail-stock. Longitudinally the work is located by a stop pin, against which it is brought up by a set-screw from the opposite side. The tail-stock is held to the jig by bolts *E* exactly as it is held on the lathe bed.

* Address: Borlänge, Sweden.

The placing of the set-screws *D* at different heights is one of the features of the jig; this makes it possible for the jig to take tail-stocks of various heights for different sizes of lathes, raising blocks being used for the smaller sizes. The raising blocks are located exactly as the tail-stock itself, so that the work placed on them will come in the same relative

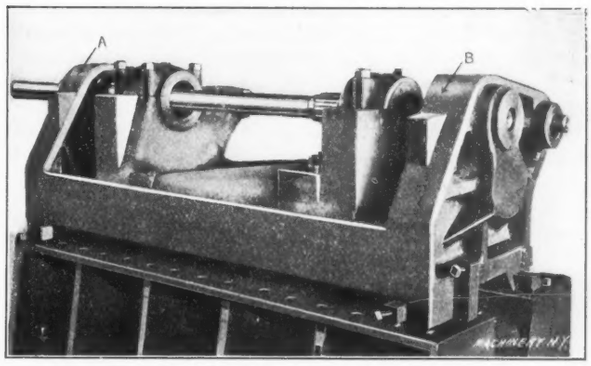


Fig. 128. Large Size Boring Jig made from a Solid Casting.

position to the uprights of the jig whether the work rests directly on the jig bottom or on the raising pieces. The two finished strips *F* are provided for facilitating the making of the jig, and the lugs *G* for the clamping down of the jig to the boring machine. The jig, however, can also be clamped to the boring machine table as shown in the illustration. At *H* is a liberal clearance between the work and the jig, allowing ample room for insertion of facing cutters, reamers, and boring tools. Ribs are provided for strengthening the jig, as shown.

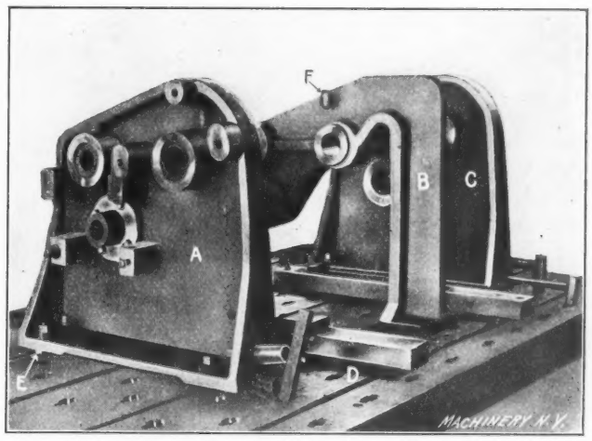


Fig. 129. Boring Jig consisting of Base-plate and Separate Removable Upright carrying the Guide Bushings.

The half-tone Fig. 128 shows a large size boring jig made from a solid casting. In this case the work to be bored out is the head of a lathe. It is located and clamped to the jig in a similar way as that mentioned for the tail-stock; clamping it to the jig in the same way that it is fastened to the lathe bed insures that the effects of possible spring will be less noticeable. Opinions differ as to whether it is good practice to make up a jig of the size shown in one piece, the distance between the standards *A* and *B* being from four to five feet, or whether it would be better to make loose members located on a base-plate as shown in Fig. 129. The writer advocates the making of one piece jigs of as large sizes as possible because, with loose members as shown in Fig. 129, there is no assurance that the standards are located correctly in relation to each other or to the work to be bored, and it involves more or less work to get the jig in order. The jig

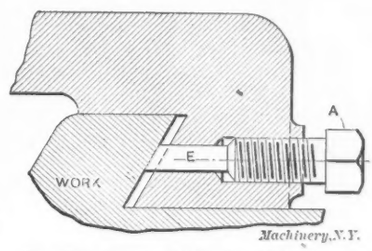


Fig. 130. Means for Holding Work against Locating Side of Dove-tail Slide of Boring Jig in Fig. 126.

in Fig. 128 does not need to be as heavy as would be inferred from the illustration, because a large portion of the bottom can be cored out.

The boring jig illustrated in Fig. 129 consists of four parts; the upright members *A*, *B*, and *C*, and the base-plate *D*, which latter may be used for all jigs of similar construction. This type of boring jig is used only for very large work. In the case illustrated, large lathe heads are to be bored. The work is located on the base-plate between the two members *A* and *C*. The member *B* is only used when the distance between *A* and *C* is very long, so that an auxiliary support for the boring bar is required, or when some obstacle prevents the bar from passing through the work from one of the outside members to the other. As a rule these members are located on the base-plate by a tongue fitting into one of the slots as shown at *E*. The members are brought as close as possible to the work, sufficient space, of course, being permitted for the cutting tools to be inserted. The standards are cored out and ribbed and lugs provided so as to give the bearing bushings long and substantial support. Good results will be obtained with this type of jigs provided they are carefully set upon the base-plate. At *F* in the member *B* is shown a boss;

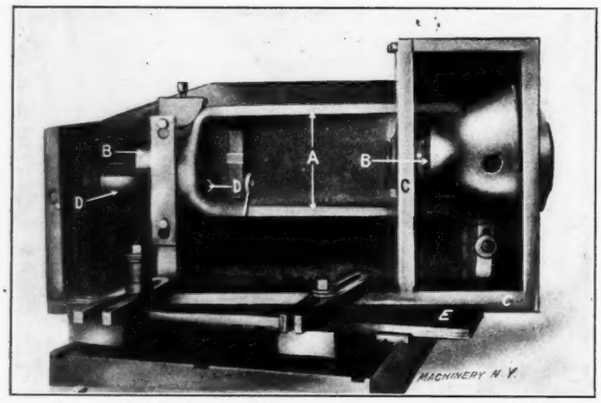


Fig. 131. Wedge-piece for aligning Work for Boring Holes with the Axes at an Angle.

this is provided with a tapped hole for a hook or eye-bolt for facilitating the moving of the jig member by an overhead crane. The other members have tapped holes on the top for the same purpose.

The jigs in Figs. 126, 127, and 128 are ordinarily used on boring lathes, but the one shown in Fig. 129 may also be used in combination with a portable driving and feeding arrangement, one type of which is shown in Fig. 135. The lugs and finished bosses on the side of jig member *A*, which do not carry bushings, are used for connection to this drive and feed mechanism.

Fig. 133 shows a boring jig of the loose member type provided with motor drive for the boring bars. The members are mounted on the base *A*, located by the tongue *B*, and

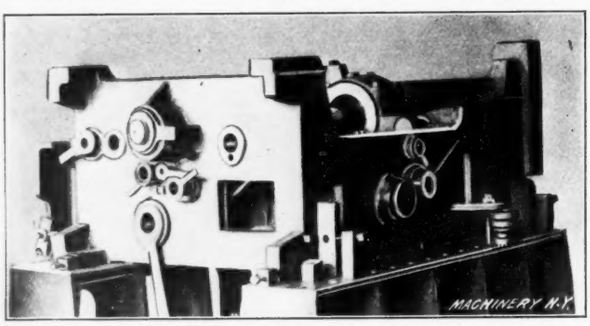


Fig. 132. Combined Drilling and Boring Jig used with a Horizontal Drilling and Boring Machine.

clamped down by T-bolts. The work *C*, a lathe head, is placed on the extension piece *D*. The boring bar is driven from the the motor by means of a worm and worm-wheel, the bar being fed along as shown in Fig. 135. In this engraving, *A* represents the work, *B* and *C* the jig members, *D* the motor which is belt-connected to the pulley *E*, which, in turn, through a worm-shaft *F* and the worm-wheel *W*, drives the boring bar *G*; this latter is keyed to, but at the same time is a sliding fit in, the worm-wheel. The bar is fed forward by the feed-screw *H* which passes through the stationary nut *J* fastened to the base-plate. The motion of the screw is actuated from the bar itself through a train of gears. The gear *K* is keyed to the screw and driven by the gear *L* which is mounted on the same stud as the star-wheel *M* which is turned by the pin *N* attached to the connecting head *O;* this latter rotates

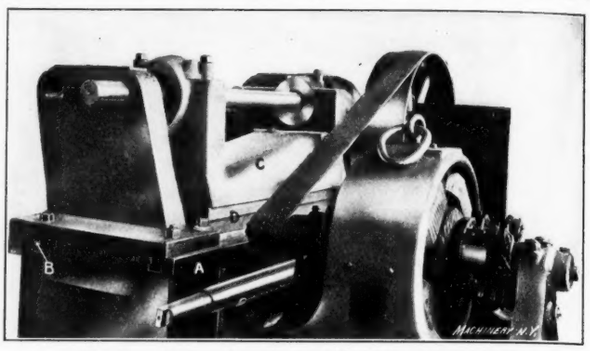


Fig. 133. Boring Jig with Portable Motor-driven Drive.

with the boring bar, but the screw *H* is a free-running fit in *O*, and simply has a thrust washer at its end to take the feed thrust. More or less feed can be arranged for by using more than one pin in the connecting head. The pin or pins can be pulled back when the feed is not required. The gears and star-wheel are mounted in the bracket *P* which follows the bar and which is prevented from turning by the rod *R* fastened to the bracket. The bar can be pushed back by using a wrench or crank at the end of the feed screw.

The feed arrangement shown, has proved very serviceable and reliable. A separate and portable drive, of the type indicated, is quite necessary for large boring jigs as there are few machines large enough in the ordinary shop to handle such heavy work.

In Fig. 131 is shown a boring jig for boring out the top frame *A* of radial drills. The design of the jig is simple but effective; the hole *B* is parallel with the finished side

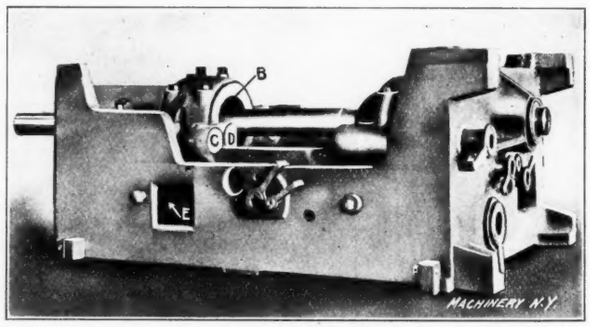


Fig. 134. Another View of the Jig in Fig. 132. Note that Holes are drilled or bored from All Sides.

C of the jig and is bored out after the jig has been brought up square against a parallel and strapped to the machine table. The hole *D* is bored at an angle with the hole *B*, and the setting of the jig for the boring out of this hole is facilitated by providing a wedge-shaped piece *E* of such an angle that the jig will be set in the proper position when moved up against the wedge. If universal joints are used for connecting the boring bar with the driving spindle, the setting of the work at an angle could be omitted, although it is preferable even when using universal joints to have the boring bars as nearly as possible in line with the spindle. This eliminates a great deal of the eccentric stress, especially when taking a heavy cut with coarse feed.

Boring operations are sometimes carried out using parts of the machine itself as guiding means for the boring bars, and in some instances it is very essential that boring operations be performed in this way in order to obtain perfect alignment. In Fig. 136 is shown a line engraving of a machine bed with the head-stock solid with the bed. In the top view is shown a method for boring out a hole at *B* by the use of two jigs *C* and *D* which are located on the V's of the machine and held down by hook bolts. If the hole *B* only passes

through the part *E* of the head this would be the preferable way of boring it. In some instances, however, the hole *B* may be required to be in alignment with the holes in a carriage or in a bracket as at *F* and *G*. These holes, of course, can then be used to great advantage as guiding means. Should the holes be too large to fit the boring bar, cast iron bushings can be made to fit the holes and the bar. In the elevation and end view of Fig. 136 is shown how a cross-slide carriage and apron *I*, which has a hole *J* in line with the holes in

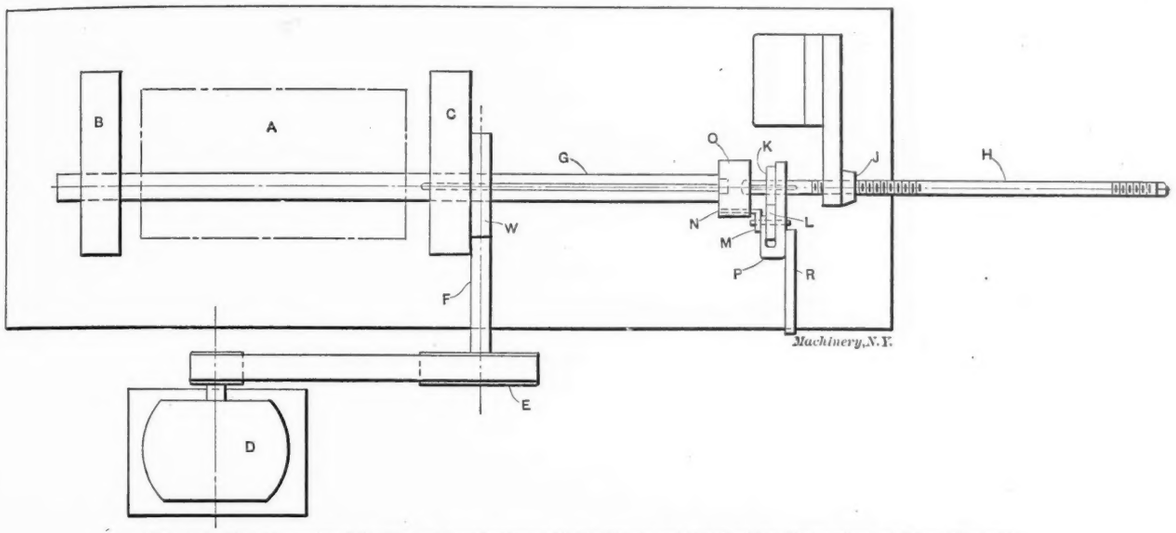


Fig. 135. Diagrammatical Outline of Arrangement of the Drive and Feed of the Boring-bar of Jig in Fig. 133.

bearings *K*, *L*, and *M*, and travels between *K* and *L*, can be bored out by using the brackets *K*, *L*, and *M* to guide the boring bar. By keying the traveling part *I* close to the bracket during the boring operation, as illustrated, accurate results will be obtained. It is evident that two of the bearings could be bored out by using the finished bearing and the traveling part *I* as guiding means. Arrangements of this kind usually save expensive tools, and often give better results.

Combination Drill and Boring Jig.

Jigs for performing both drilling and boring operations are frequently used to great advantage. In designing such jigs, however, judgment must be displayed not to arrange for combination jigs when the operations can be more easily performed in two separate jigs. Sometimes it is advisable to have a jig for the boring alone, and then to use the bored holes for locating the work in a separate drill jig. In other cases it may be better to do the drilling first and locate the work for the boring operations from the drilled holes. The designer should decide which method would be preferable, considering, in the first place, the factors of the time required and the accuracy of the work. To give any definite rules for this work is not possible; but it may be said that combination jigs should be used only when the drilled and bored holes are somewhat near the same diameters. When the holes are of widely different diameters two jigs are preferable. If a few screw-holes of small diameter for holding a collar or bracket, for instance, located around a large bored hole, were to be drilled with the same jig used for the large hole, the jig when used on a small drill press would be entirely too heavy to manipulate. It is likely that in such a case a small separate drill jig could be attached directly to the work. In other cases, however, it will prove a distinct saving to combine the boring and drilling jig in one.

In Figs. 132 and 134 is shown a combination drill and boring jig of large size. The work *A* in Fig. 134 is a head-stock for a lathe with a number of holes to be drilled. The large holes *B* at both ends of the head-stock are cored as usual, and allow the boring bar to enter for taking the roughing cut. The holes at *C* and *D* are opened up by drills previous to the boring operation. As there is considerable distance between the end of the head-stock and the uprights of the jig, long bushings are used to give the drill a good bearing close to the work. The small holes which are drilled and reamed are shown in Fig. 132. Both the drilling and boring operations may be performed on a horizontal boring and drilling machine. As the horizontal drilling and boring machines usually have adjustments in all directions, the only moving of the jig necessary is to turn it around for drilling the holes on the opposite sides.

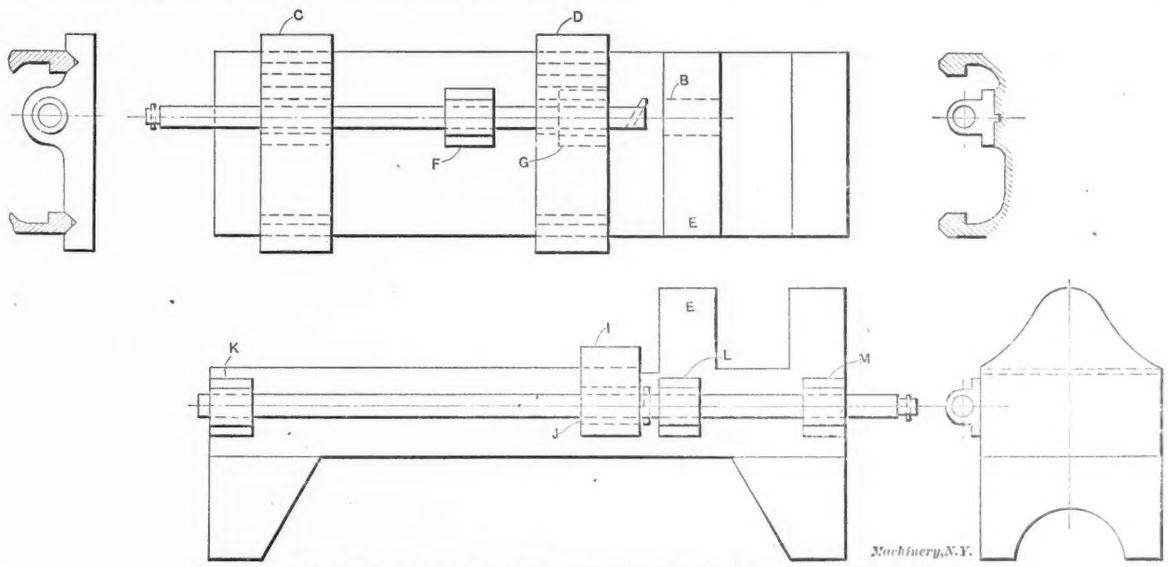


Fig. 136. Examples of Boring where Parts of the Machine being built are used as Guiding Means.

SHOP PHOTOGRAPHY.*

H. P. FAIRFIELD.†

I have read with much interest the article by H. C. Estep on "Shop Photography," which was published in the December issue of MACHINERY. He speaks of his experience with films and makes a statement about glass plates and halation which has not been borne out in my case or in any case of which I know. Negatives entirely free from halation are as easily and truly made upon glass plates as upon films. The only condition necessary is to give the proper exposure. If this is done, a perfect negative results which is free from deep shadows, halations or false high lights on any good make of glass plates or films. Proper exposure must, as in any case, be reinforced by exact and scientific development, and this can be obtained by using the tanks and developer powders sold by the Eastman Co. Mr. Estep's article conveys the idea that the so-called films are peculiarly free from halation troubles. My point is that there are no differences in this respect, whether using glass plates or films, and that when given the right amount of exposure and scientific development, either will give a perfect negative free from halation under the most adverse conditions. While the proper amount of exposure given a plate is not the whole of photography, by any means, it is a considerable factor in any case and perhaps the hardest single item to correctly gage. Mr. Estep's method of teaching exposure by obtaining a "standard" is along the lines of the best practice.

As to what causes halation, I do not know, but I have figured it out that its *effect* is made *visible* on the negative by over-development when trying to bring out detail in the shadows, as the darker parts of the picture are termed. Take, as an example, an interior with windows on one or even two sides, of which it is desired that a view be taken looking directly at these, as shown in Fig. 1. The camera is thus facing the source from which all the illumination is coming and all objects in front of the camera have their deepest shadows facing the lens. The operator is naturally misled by the glare from the windows in his eyes, and forgets that the shadow sides of the objects (machines for example) are reflecting into his eyes, or the lens, very little light indeed. Under this influence he invariably misjudges the time of exposure, undertiming the plate or film and really obtaining no image of the shadow areas on the sensitive plate. When the plate or film is placed in a normal developing solution, the windows and adjacent areas being strongly lighted, develop, as it is termed, in their proper time, while the darker or shadow areas have not reflected sufficient light to affect the sensitive plate or film, enough to register a distinct image in the time it takes to develop the strongly lighted areas. Usually, in such cases as this, the operator prolongs development with the hope that he can get something to show where, practically speaking, the light has made no impression upon the plate. Pushing development in this manner builds up or thickens the strongly lighted areas on the negative, and, in the case of windows and adjacent strongly lighted areas, obliterates practically all the detail. If the operator can be made to believe, at the beginning, that such a plate is hopeless, and if he will discard it and obtain one with a correct exposure, much will be gained. Dr. John Nicol, who for years has been editor-in-chief of the *American Amateur Photographer*, has repeated a thousand times in that publication this motto: "Expose for the shadows—the high lights will take care of themselves." The sensitized coating of the negative, upon which the light impresses the image, is alike in like grades for either plates or films. The usual supports for the coating are glass plates in one case and a flexible support of celluloid or paper in the other, the coating remaining the same, and exposure being the same whichever is used.

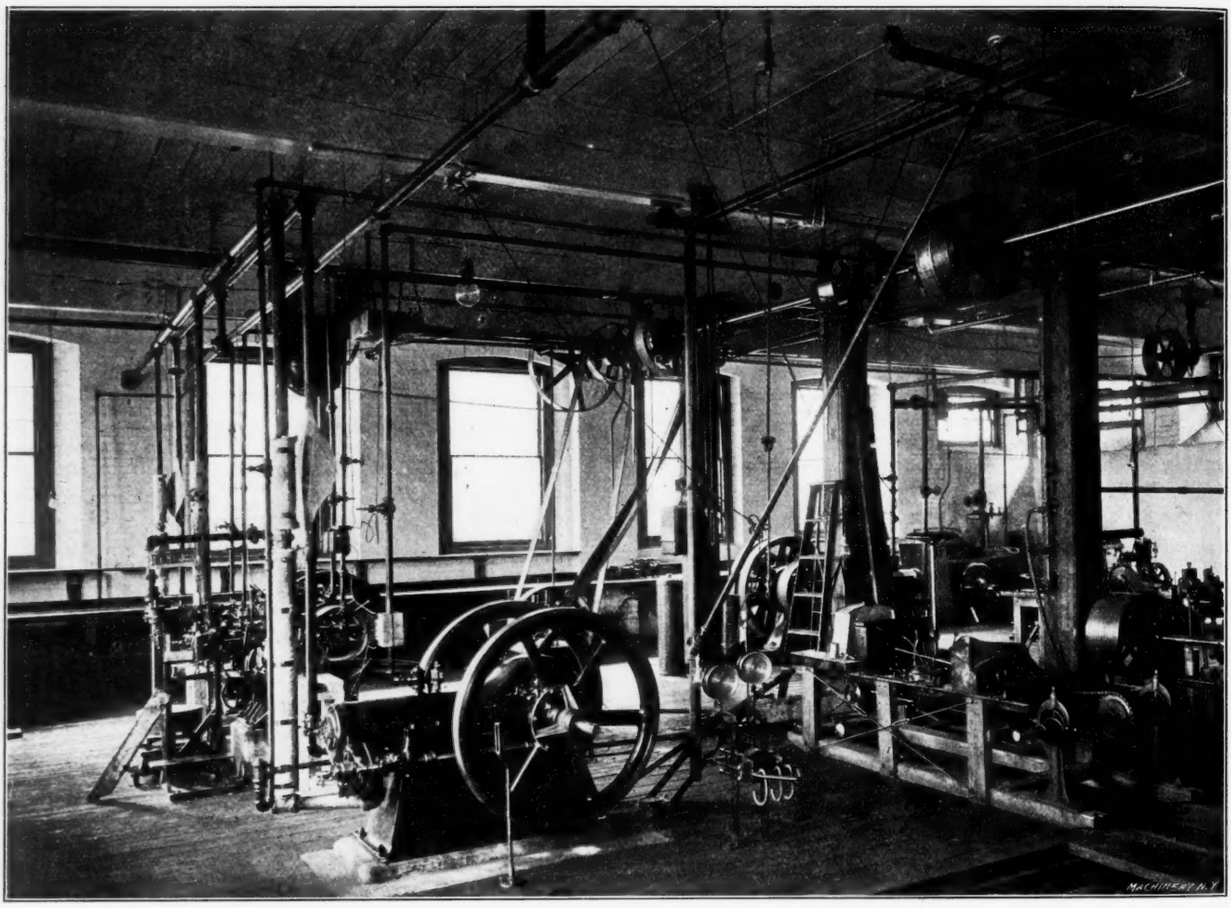


Fig. 1. Type of Interior which is often Under-exposed, the Exposure being made for the High Lights instead of the Shadows.

A word as to what I mean by scientific development. Several firms, notably the Eastman Co., have carried on elaborate experiments to learn all that could be learned regard-

* For additional information on this subject, see the following articles previously published in MACHINERY: Industrial Photography, January, 1909; Shop Photography, December, 1908; Correcting Perspective in Shop Photography, February, 1908, and other articles there referred to.

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ing the action of developers and the correct timing of development. This has been done under the direction of expert chemists and manipulators, and when under such conditions results are published, they can be taken as reliable. The tank method of development can be performed in an ordinary tray, but is more neatly and pleasantly done in one of the modern plate or film tanks. The principle is this: Given a developer of a certain strength, its action on the plate should be limited to a definite interval of time. Action continued beyond this stated time not only does not result in any increase of detail, but actually thickens, halates and fogs

Fig. 2. Negative made on a Standard Glass Plate during a Bright Sunny Day. Note Absence of Halation.

the results thus far obtained. Experiments scientifically carried out have determined what this time should be for various developers when in solution as directed. Given such a known developer, some suitable sort of a tank to hold the plates and solution, means for measuring time, a thermometer for indicating temperatures, and all there is in the negative must be obtained. An accurately and properly timed exposure, a developing solution of known strength, at a correct degree of temperature allowed to act upon the negative a scientifically determined period of time is "It." In Fig. 2 is shown a half-tone reproduction of a print taken from a 5x7 negative made during a bright sunshiny day on a standard glass plate of the ordinary sort, unbacked or doctored in

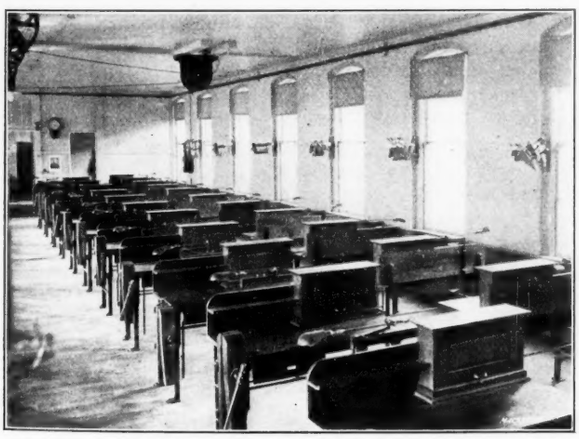

Fig. 3. Another Splendid Interior in which Every Detail is brought out without Halation around the Windows.

any manner. The plate was developed in the Eastman plate tank. The windows shown are of Southern exposure and were left exactly as shown in the picture.

To anyone taking up the work, I would say that the best apparatus, materials and supplies are none too good; therefore get the best that can be afforded. This is especially true in lenses. No one using a modern Goerz or Zeiss anastigmat will ever use any other if he has the price. An anastigmat lens has nothing to do directly with halation, but is recommended as essential to the best technical work as its corrections are more perfect than the so-termed rectilinear lens. Indirectly, as such a lens can be used at a larger aperture than the cheaper lens, its use often results in a better timed negative and therefore greater freedom from "soot and whitewash." While it is a pleasure to use almost any camera outfit, the best is none too good if serious work is contemplated.

While I wish to make the point that there is no halation necessary if exposure and development are properly timed, it is seldom that the operator's judgment tells him just what is best in the exposure. For this reason, it is always wise to avoid conditions which are likely to give adverse results.

* * *

"DON'TS" FOR THE BLACKSMITH.

GEORGE T. COLES.*

Don't be afraid to strike the iron while it's hot.

Don't take two heats to do what you ought to do in one.

Don't hang hot tongs in the tong-rack.

Don't use a hot chisel to cut cold stock.

Don't use a cold chisel as a hammer—it may fly off the handle and hurt somebody.

Don't abuse your helper—it isn't his fault all the time.

Don't forget to make your bolt-heads standard size.

Don't use your hand hammer for a bob-punch—it's dangerous.

Don't borrow your neighbor's tools—make your own.

Don't alter your tongs for every job; make new ones—it pays.

Don't forget to fix your tongs when you break them.

Don't forget to use the square—your eye won't do.

Don't watch the other fellow's fire—attend to your own.

Don't watch the "boss"—watch your fire.

Don't forget to see that your tools fit your anvil—it saves time.

Don't work with hot tongs; cool them off—you'll be surprised at the results.

Don't forget that a little salt in your fire helps things wonderfully, sometimes.

Don't forget to anneal your flatters and fullers once in a while—it's time well spent.

Don't use a high carbon steel for your tools; a cheap grade is better and lasts longer.

Don't forget to take your time hardening a die—it pays.

Don't get the corners of the die hotter than the body—if you do they may come off.

Don't hammer cold steel—it's hard work, and besides, it's bad for the steel.

Don't have any "cold sets" in your forgings—cut them out before they do harm.

Don't abuse the dies of the steam hammer—your work will look bad.

Don't roll your work at the steam hammer—'twill make it hollow.

Don't be reckless around the steam hammer—it's dangerous.

Don't forget that the scale around the steam hammer is the best flux for welding.

Don't use your flatter or fuller at the steam hammer—it's dangerous.

Don't scrap the short ends—they come handy sometimes.

Don't forget to take the frost out of the steam hammer the first thing in the morning.

Don't forget to give her (the steam hammer) steam slowly first thing in the morning.

Don't forget to let her (steam hammer) run open for a few minutes first thing in the morning.

Don't forget to use a little graphite and cylinder oil on the guides—it make the hammer run easier.

Don't forget to oil up the hammer once in a while, and remember that an automatic oiler is best.

Don't forget that a steam trap is the latest attachment to a steam hammer.

Don't nick and break good carbon steel when making tools—it injures the steel.

Don't melt lead or babbitt in your fire if you expect to do any welding—it will cause trouble.

Don't forget when forging to allow 10 per cent for waste.

Don't criticise the other fellow's work—do your own quickly and well.

* Address: 1204 North Edward St., Decatur, Ill.

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Entered at the Post-Office in New York City as Second-Class Mail Matter.

MACHINERY

DESIGN—CONSTRUCTION—OPERATION.

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS,

49-55 LAFAYETTE STREET, CORNER OF LEONARD,
NEW YORK CITY.

Alexander Luchars, President and Treasurer.
Matthew J. O'Neill, Secretary.

Fred E. Rogers, Editor.
Ralph E. Flanders, Erik Oberg, Franklin D. Jones, Associate Editors.

The receipt of a subscription is acknowledged by sending the current number. Checks and money orders should be made to THE INDUSTRIAL PRESS. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Single copies can be obtained through any newsdealer.

We solicit exclusive contributions from practical men on subjects pertaining to machine shop practice and machine design. All accepted matter is paid for at our regular space rates unless other terms are agreed on. All copy must reach us by the 5th of the month preceding publication.

FEBRUARY, 1909.

PAID CIRCULATION FOR JANUARY, 1909, 21,865 COPIES.

MACHINERY is published in four editions. The practical work of the shop is thoroughly covered in the Shop Edition, $1.00 a year, which comprises approximately 650 reading pages and 36 Shop Operation Sheets, containing step-by-step illustrated directions for performing 36 different shop operations. The Engineering Edition—$2.00 a year, coated paper $2.50—contains all the matter in the Shop Edition, including Shop Operation Sheets, and about 250 pages a year of additional matter, which includes a review of mechanical literature, and forty-eight 6 x 9 data sheets filled with condensed data on machine design, engineering practice and shop work. The Foreign Edition, $3.00 a year, comprises the same matter as the Engineering. RAILWAY MACHINERY, $2.00 a year, is a special edition, including a variety of matter for railway shop work—same size as Engineering and same number of data sheets.

THE EXPERIENCE OF PURCHASING AGENTS.

The recent experience of a foundry company in marketing a specialty is an example of present-day problems in distribution, and as the facts involved throw some light on the results produced by removing the purchasing department of an industrial undertaking too far from the influence of the mechanical department, it may be worth while placing on record. The foundry firm in question is making a special casting used on railway cars, which is made in such a manner that a great deal of the work in fitting is saved when the part is applied to the car. In obtaining orders for these castings, it has been found that it is very easy to introduce them with small companies where the master mechanic directs the purchase of materials; but when it comes to the large companies which have special purchasing agents, who as a rule are unfamiliar with mechanical requirements, it has been found difficult to introduce this product of the company. The casting spoken of is of a very special type, is cast in a somewhat different manner from ordinary castings, and must therefore necessarily be more expensive, pound for pound, than are regular castings. The purchasing agent who lacks mechanical experience, however, measures the value of castings simply by the weight, and expects to pay so much per pound for castings, irrespective of the manner in which they are produced and the purpose for which they are intended. The mechanical man, on the other hand, especially if he be in charge, and responsible for the economical results obtained, would immediately realize, in a case such as here referred to, that the casting, as made, possessed a distinctive value because of saving a considerable amount of labor expense and trouble in fitting to the car in the shop.

This example illustrates one of the defects in the organization of large industrial concerns where the influence of mechanically trained men is not directly felt in the business office, and where the management, therefore, is entirely in the hands of men whose whole training has been confined to office work and to whom mechanical features have not the same significance as to men who have been trained in the productive departments. At the present time, undoubtedly, this defect of administration is growing, due to the formation of large corporations which replace the smaller individual concerns. In the former, the man of business training, as a rule, entirely overshadows the mechanic, and this is by no means always to the best interest of the firm. Many thousands of dollars are lost yearly by large industrial concerns on account of the lack of appreciation of mechanical requirements in the purchasing department.

* * *

HABITS OF WORK.

Several years ago the writer visited a well-known engineering school, and naturally included the machine shop or "mechanical laboratory," in which the students were instructed in the elements of machine construction and operation. The class at work at the time was building a universal grinding machine from castings furnished by the manufacturer. Among the parts being machined was the platen, which was being planed by one of the "boys." He was "nursing" the job by taking an insignificant cut with an almost microscopic feed. At the rate the planing was proceeding, half a dozen cuts would have been required to finish the surface, and the time of each cut would have been about three times the normal.

In response to a comment that the cut and the feed were rather below the average machine shop practice, the guide volunteered the information that the boy was employing this expedient to keep the machine going until the instructor could reach him, without endangering the job. It was apparently the common practice to proceed in this leisurely manner in order to avoid mistakes. The instructor thus could keep in close touch with the state of each boy's job, and nothing was likely to go far astray between his visits. The plan, of course, was commendable from one point of view: that is, avoiding mistakes and spoiling work, but it was a very serious defect, as any practical mechanic will immediately concede. While the boys received practical instruction in the manipulation of machine tools and production of finished machine parts, they did not acquire another kind of instruction in a matter equally as important, and that is, speed of performance.

A graduate from this or any other engineering school conducted in a similar way, would find in going into a manufacturing plant that he was in a strange world. The changed conditions would virtually make him a stranger to the work with which he should be quite familiar. He would be unable to do commercial work satisfactorily until he had acquired considerable experience, and would be incompetent to direct the work, even as a sub-foreman, simply because he has no conception of commercial speeds.

A more serious fault of such methods of instruction is that the learner cannot do his work as well as though it were done at his best speed. This may seem strange to those who have not given the matter thought, but it is a fact confirmed by numerous observations that the best work is that done rapidly and with care. In mass production it is much easier to make 99 out of 100 parts meet all the requirements of a rigid inspection system than if each part were made slowly and individually. In passing, it may be remarked that mass production is one part of the secret of the extraordinary accuracy of the Swedish gages that have excited the wonder and admiration of the whole mechanical world.

The value of habits of industry acquired under the system of training that teaches quickness and dexterity as well as skill, is admirably treated by Mr. Gantt in his paper "Training Workmen," read before the December meeting of the American Society of Mechanical Engineers. "Habits of work are comparable with habits of thought in engineering," and inferentially an engineer's training should include the right habits of work as well as the right habits of thought if he is to direct industrial operations.

* * *

From observations of manufacturing cost in many machine shops, Mr. James Hartness, president of the Jones & Lamson Machine Co., Springfield, Vermont, has concluded that for the purpose of estimate, it may be taken that one-third the cost is labor, one-third material, and one-third shop burden. Lathe work is usually one-half the machining or one-sixth the total cost of production.

MACHINE TOOLS AND THE TARIFF.

The advanced development of the machine tool industry in this country, and the use of ingenious cost-saving appliances as well as the greater skill and productiveness of American workmen, have enabled our manufacturers of certain kinds of tools, which are turned out in large lots, to so reduce costs that they have been able to market a considerable portion of their product abroad in competition with foreign machines, which until recently have been produced in small lots only. This class of American manufactures would be the least affected by a moderate reduction in our tariff; but very heavy tools which are made largely of cast iron, many of them special tools, need more protection. There are many cheap and cumbersome machines made by English, German and other European manufacturers, which could hardly be sold in this country at any price; but, on the other hand, most of our best tools are now accurately copied by foreign makers; and, unless our manufacturers were protected, could be sold in this country at prices which would completely demoralize the American machine tool industry. Progressive foreign manufacturers recognize the superiority of American methods and are rapidly adopting them; and all they really need to compete on even terms with our own manufacturers, anywhere, is a larger market, which means larger production.

For fifteen or twenty years American machine tools have been sold all over Europe in competition with foreign makes, at virtually the same prices as in this country; and our export trade increased rapidly up to 1907. During that year, although we had then begun to feel the effects of foreign imitations, most of our leading machine tool builders were from six months to a year behind in their deliveries. The development of our machine tool industry has never been so great as during the period above referred to, and within that time the number of manufacturers and the output increased three or four fold. The steady and rapid development of this industry naturally resulted in stronger competition among our manufacturers, and in remarkable development in the capacity of our machine tools. No sooner did one manufacturer place an improved machine on the market, than his competitor set to work to better it; and often produced one at the same price which would turn out more work at less cost. The automatic screw machine is a type of labor-saving tool of distinctly American origin. One of these machines easily turns out from five to twenty times the product of an ordinary engine lathe, at a cost for direct labor attendance, in some cases, of less than one-tenth that of the latter. Many other machines of the screw-machine type have been perfected, which have completely revolutionized the manufacture of small parts, effecting savings fully as great. Almost without exception these machines are being copied by European makers, who, of course, are under no expense for originating, developing and perfecting them, yet under a lower duty they could and would undersell the originators in this market, on account of the difference in the cost of labor. How great this difference is is shown by the following tables:

Foreign.	Machinists.	Tool-makers.	Handy-men.
Italy	8 to 12	12 to 16	9 to 10
Switzerland	15	20	10 to 12
Germany—			
Munich	13	17	10
Saxony and the Rhine Valley.	15	20	11 to 12
Berlin	14.5 to 17	19 to 22	11 to 13
Magdeburg	14.5	19	8.5 to 10
Great Britain	15.5	20	9
France	Machine tool industry still in its infancy.		
United States.			
New York City	33	39 to 44	16 to 28
Philadelphia, Pa.	31 to 37	32	16
Providence, R. I.*	26	28 to 35	18 to 25
Hartford, Conn.	32	37	20
Cleveland, O.	25 to 30	30 to 35	18 to 25
Cincinnati, O.	27	32	20 to 30
Milwaukee, Wis.	25 to 40	30 to 40	17½ to 25

* On piecework these rates may be increased 30 to 40 per cent.

The United States will always be the greatest market for our machine tools, and while the cultivation of foreign trade should continue to be of prime importance, in considering the tariff on such products we must be careful not to sacrifice the kernel for what might prove to be the husk.

MACHINERY'S EDUCATIONAL WORK.

The editorial policy of a journal like MACHINERY takes cognizance of the several important functions the publication performs in its relations to a multitude of readers, among whom there is a wide disparity in age, experience and ability. MACHINERY is a trade journal, publishing the general news of the trade it represents, which is one function. It is a technical journal, presenting the technical news of the trade, which is another. It is a forum for the discussion of questions of importance to the trade, technical and commercial. It is also a journal of education for students of machine design and shop practice, and we state without hesitation that this function is the most important of all, and is the one which chiefly characterizes and distinguishes MACHINERY.

The school of engineering likely to graduate men best equipped for the practice of engineering is the one which, in teaching fundamental principles, does not fail to train its students in the ability to detect these amidst unfamiliar details and in novel and unforeseen circumstances. When a man can do this, and can apply the fundamental principles of his vocation to creative work, he is trained. This is what technical schools are for, and this is the ultimate distinction between the trained and untrained man. One gropes for his principles, finally reaching them through costly experiment; the other goes straight to the heart of the matter, sees the principle and applies it.

In this sense MACHINERY is essentially a school of engineering. Every accurate and adequate account of a piece of mechanical work done in field and shop and drafting-room, is a lesson in mechanical practice and an elucidation of the principles involved. All experience is educational, or would be, if properly classified and logically arranged. MACHINERY collects, as it were, the mechanical experience of the month, discards what is unimportant or merely incidental, condenses and classifies the remainder, and endeavors to so arrange and adapt the matter that it becomes logically and properly a permanent part of the body of approved mechanical knowledge. This important educational function of the technical journal is well recognized by educators, one of whom happily designated MACHINERY as "a progressive textbook for mechanics."

And in the sense that MACHINERY is a progressive textbook, there is a weight of responsibility to a great body of readers, including men at the very top of the engineering profession, who read to keep in touch with the latest developments, expecting to find them reliably chronicled here; and that much greater number of machinists and draftsmen who also wish to keep up to date, but to whom an account of the latest developments would, in many instances, be of little educational value unless presented in such a manner as to supply any deficiencies in technical education or practical experience. Take for example the series "Jigs and Fixtures" now appearing, in which the treatment of the subject is very characteristic of MACHINERY. These articles are published primarily to describe the general practice, which presents many interesting and valuable features. Yet the whole subject is reviewed, the principles formulated; and when completed the series will comprise a complete treatise on jig and fixture design brought up to date. The series of articles on shop construction, which began with September, is another good example of this educational work. The problem of shop construction is analyzed, the general rules and principles clearly stated, and then, specifically, the actual details of construction for a plant of a certain size, intended to produce at low cost.

The Shop Operation Sheets which teach shop practice and incidentally the principles, are examples of this practical educational method, further exemplified in the "jig" method of instruction used so successfully by Mr. Renshaw, the originator, in his school in Cincinnati. The "jig" idea fits in well with our educational system and has been adopted here to be developed and given wider usefulness in conjunction with the rest of our educational material and equipment which includes MACHINERY, the Reference Series, Data Sheets and Shop Operation Sheets.

ENGINEERING REVIEW.

CURRENT MECHANICAL EVENTS—LEADING ARTICLES OF THE TECHNICAL PRESS.

It is stated in the *Daily Consular Reports* that the centenary of the re-establishment of national independence in Holland will be celebrated by a world's fair to be held at The Hague in 1913. It is stated that the grounds for the exposition have already been secured and a guarantee fund provided.

An application of the Lumière process of color photography, which appears to be both interesting and valuable, is described in a recent issue of the *Revue de Métallurgie*, where a number of microphotographs made in color by this process, are reproduced. The structure of metals is much more strikingly represented than with the usual black and white prints.

It is stated in the *Horseless Age* that the following composition is used extensively for typewriter levers: copper 57 per cent, nickel 20 per cent, zinc 20 per cent, and aluminum 3 per cent. These parts, even when the nickel on the surface is worn off, never rust. The alloy is very hard, but may be bent to a considerable extent without breaking.

According to the *Railway and Engineering Review*, experiments have been undertaken for several years with concrete ties in Italy, and the Italian government has now ordered 300,000 of these ties, or enough to lay about 100 miles of track. The ties are reinforced with small round iron rods and weigh 286 pounds each, of which 28 pounds is metal. The cost of the ties is $1.20 each. The ties will have creosoted oak bearing blocks.

The forests of the United States, according to reports of the Forest Service, now cover approximately 550,000,000 acres, while the original forests covered at least 850,000,000 acres. The government owns about one-quarter of the total forest area, which contains one-fifth of all the timber now standing. Those timber lands which are owned privately are generally more valuable than those of the government, but are far less carefully managed.

The first commercial wireless telegraph station conducted by the British post-office in connection with the regular British telegraph service, was opened on December 11 at Bolt Head, South Devon, on a height 430 feet above sea level. The range of the station is 250 miles, and it can be used for communication with all ships at sea fitted with wireless apparatus, as well as with the channel islands, in the event of interruption of the communication by the regular cables.

A brown color can be produced on all kinds of metals by the following process, described in the *Brass World*. The work to be treated is first bronze plated by a regular bronze solution of copper and zinc. When a good deposit has been produced, the article is rinsed and immersed in a solution of 2 ounces of liver of sulphur to one gallon of water. This solution is used cold. When the desired color has been obtained, the work is again rinsed and then scratch brushed. In this manner the whole surface is shaded down to a brown color.

An interesting use of electric light has been made by the city authorities in Chicago. The street sweepers on the more important boulevards in the city found their work hampered and rendered dangerous at night by carriages and automobiles. In order to relieve the danger, each man is provided with an electric lamp attached to his helmet. and fed from a storage battery in the sweeper's pocket. The entire outfit weighs less than a pound and, according to the *Scientific American*, the lamp will burn ten hours without recharging the batteries.

For several months the United States wireless telegraph station at San Francisco has received calls supposed to have come from Japan, where one of the most powerful wireless telegraphic apparatus in the world is installed. The distance the messages have been transmitted is 4,700 miles. Although the operators at San Francisco have been unable to reply owing to the smaller size of their apparatus, it seems probable that it will be possible before long to establish direct communication across the Pacific Ocean. The instance referred to marks a record for the transmission of wireless messages.

The price of aluminum has fallen considerably during the past year and according to *Chemiker Zeitung*, the price in Germany during the latter part of the past year was only 150 Mark per 100 kilograms, which is at the rate of only 16 cents per pound. It is interesting to notice how the price of aluminum has declined since 1855. According to the source mentioned the price in 1855 was $106.00 per pound; in 1856, $32.00; in 1857, $10.60; in 1886, $7.10; in 1888, $5.00; in 1890, $1.52; in 1891, $0.83; in 1895, $0.32; in 1900, $0.22; in 1905-1906, $0.40; in 1907, $0.43; in 1908, $0.16.

We are accustomed to speaking of the workless as "the unemployed," but the *San Francisco Star* long ago brought into use a truer word—"disemployed." For the merely unemployed, we need have no especial sympathy if they are poor, nor any extraordinary respect if they are rich; for "unemployment" means no more than idleness. But "disemployment" connotes all the agony of the worker in a period of hard times, when he can find no work to do. And as this condition comes from social maladjustment, the resulting lack of employment is best expressed as *dis*employment. It is enforced unemployment.—*The Public.*

In a talk before the Sphinx Club, New York, November 10, Dr. Harvey Wiley, Chief of the Chemical Bureau, Department of Agriculture, made a statement in regard to trade-marks that is worth the attention of all manufacturers using trade-marks. The Court of Appeals, District of Columbia, has handed down a decision in regard to trade-marks and advertising that will tend to check misrepresentation. The court will not protect any trade-mark about which false statements are made in advertising. If a manufacturer labels his goods properly and advertises them falsely, then by the decision of the court, he is not protected in his trade-mark rights.

Bare aluminum wire may safely be used in coils without any insulation except between successive layers, owing to the existence of a film of oxide on the surface of the aluminum. The film in its natural state, says the *Scientific American*, will resist 0.5 volt; but by exposing it to the air at a temperature of about 100 degrees C. it is possible to get rid of the hydrates contained in the film, and thus increase its resistance so that it will withstand a high voltage. The insulation between the layers of the coil should be non-hydroscopic, and the coils should be covered with insulating paint to prevent moisture from entering.

The United States Steel Corporation, recognizing the great economic loss caused by accidents to life and limb, is instituting a system of accident prevention, safeguards for machinery, and inspection of same in all its plants. It issued a call to all managers of plants for suggestions for methods and safeguards and received in response about 2,500 ideas. A very large proportion of these ideas was accepted, about 2,300 being found feasible. The managers of the corporation recognized the fact that it is not sufficient to install safeguards and methods designed to prevent accidents alone, but that it is also necessary to provide an efficient inspection system by which these safeguards and methods would be maintained. It is a sorrowful fact that workmen themselves are the greatest enemies of accident preventive devices, especially when they interfere in the slightest with machine operation. Another point affecting safety appliances that is important in a corporation having constituent plants operated in competi-

tion as are those of the U. S. Steel Corporation, is that the individual plants are not charged directly for the cost of maintenance, which is charged to administration expense. Under such arrangement no superintendent feels that his mill is being taxed for a feature that could be avoided and which he might fiercely antagonize were it charged directly against him. Charging this expense against a general overhead fund alters the complexion of the charge entirely, from the individual manager's viewpoint. It is gratifying to note that America's greatest corporation has recognized its responsibility in reducing the appalling loss of life and maiming of employes in industrial work. Its example should be very helpful in leading other concerns to give the matter the attention that its importance demands.

TRAIN DISPATCHING BY TELEPHONE.

The Atchison, Topeka & Santa Fé Railroad has announced that it will soon operate its entire main line, from Chicago to the Pacific Coast, by telephone instead of by telegraph. Contracts have already been let for a part of the needed installation, which will cost about $2,000,000. The Union Pacific has already installed 123 miles of telephone betwen North Platte, Neb., and Sidney. The New York Central has been dispatching by telephone between Albany and Syracuse, and is extending the system to Buffalo. The Erie has been for some time doing the greater part of its dispatching in the New York suburban district this way. The Great Northern is installing a thousand miles of 'phones, and the Pennsylvania is trying out this system.

The availability of the telephone for train dispatching was discovered when the railroads found that an immense volume of complex business was being successfully handled by telephone between city freight offices, receiving docks, and freight yards, involving the telephoning of contents of way bills and slips containing many figures. When the National and State laws limiting the working hours of railroad telegraphers to nine and eight hours, put added operating expenses on the roads, and the unions would not agree to the employment of apprentices to help keep down the cost, the railroads began to try out the telephone in dispatching, with the result that it is coming into general use. Any person of ordinary intelligence can send and receive orders by telephone, and some of the best tower men to-day are disabled trainmen put at this work.

There is no question of safety involved. The universal use of block signals has taken from train dispatching the work of preventing collisions, and dispatching is now purely the management of traffic. The telephone has been found more efficient than the telegraph for this.—*New York Times.*

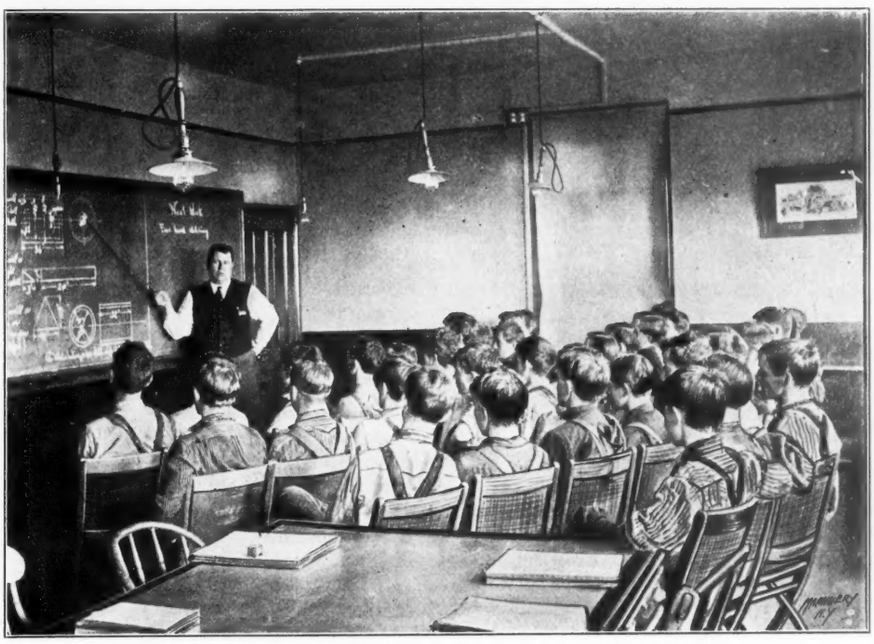
EDUCATING APPRENTICES AT DRIFTON.

In an article on educating apprentices, contributed to *Mining Men* (September, 1908) by Mr. William Lloyd, superintendent of the Lehigh Valley Coal Co.'s shops at Drifton, Pa., the author wrote in part as follows:

"I have found by experience that in a force of about forty apprentices there are about 25 per cent who will avail themselves of the usual opportunities for self-education, about 50 per cent can be persuaded by their employers to attend night school—if the employers are progressive enough in educational matters to make some effort in that direction—and the other 25 per cent cannot be prevailed upon to take these advantages under any circumstances. It was just to take care of the last mentioned that gave me the first thought of our school. About two years ago I had the honor of being appointed on the board of directors of the Mining and Mechanical Institute of Freeland, that splendid school for boys and men which was founded by the late Eckley B. Coxe. It was through my connection with this school that I was enabled to more fully realize the advantages of a school for the boys at the shop.

"In building up our force of apprentices I made it a rule to have each one promise to attend the night school at the Mining and Mechanical Institute. I found that some were regular pupils already, and there were some who could be persuaded to attend, while—as I said above—a certain percentage would not take this splendid opportunity to better their condition. One reason I found for some not wishing to start, was that their early education had been almost entirely neglected, so at the ages of sixteen or seventeen years they were ashamed to start; thus the only solution was compulsory education; in other words, we make going to our school a part of their work, for which they are paid.

"Years ago my experience with mechanics in nearly all trades convinced me that there is a very small percentage who can make an intelligent free-hand sketch, so we started by making free-hand sketching one of the leading features in our school; and it is remarkable what talent some of the boys show in this study. I know of no trade in which a man is not better off if able to intelligently put his ideas on paper.



Instructing Apprentices at the Lehigh Valley Coal Co.'s Shops, Drifton, Pa.

Therefore, in the near future we expect to teach the boys to write letters such as a mechanic is called on to send to the works when out erecting machinery. This I know to be very important, for a great deal of time is lost and serious mistakes sometimes occur, because such letters do not intelligently convey the man's ideas to the shop superintendent.

"We have started on a plan of lectures by the foremen of the different departments. Our idea in doing this is that the apprentices of each department may thus have some knowledge of how and why some things are done in the other departments. Besides this, we intend to give the boys special instructions pertaining to their respective trades. For instance, the machinist apprentice will be instructed in the principles of valve setting, lining up and erecting machinery, etc.; the foundry apprentice will be instructed in the principles of mixing and melting iron and other metal combinations that go in engine and pump construction, also the reasons why different sand is used in some jobs and not in others.

"The question may be asked: 'Does it pay to take this interest in the boys?' I have always believed that it would, and I am now sure that it does. We not only get more and better work out of the boys while they stay with us, but we feel when they leave that we have done our best to make good men of them, and that we are sending out mechanics who are above the average."

TOOL-HOLDER ADJUSTABLE FOR HEIGHT.

La Machine Moderne for January 1, 1909, illustrates and describes a simple tool-holder of adjustable height, which appears to be of very convenient design. It is made in two forms, as shown in Figs. 1 and 2; the first has a spring holder for the blade, while in the second case the blade is grasped solidly, this being the only difference in the two tools.

This device consists of three members: an outer sleeve *A* split as shown for clamping; an inner sleeve *B*, bored eccentrically, and also split for clamping the tool-holder proper *C*, which is hollow, to permit carrying long bars of cutting steel. In adjusting the tool for height, it is loosened in the tool-post, and sleeve *B* is rotated by a spanner wrench or pin inserted in the holes drilled in the periphery of its flange. The rotating of this sleeve raises or lowers its eccentric bore, and

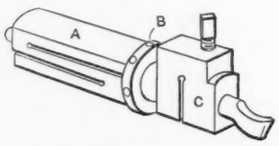


Fig. 1. Spring Tool-holder, of Adjustable Height.

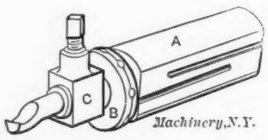


Fig. 2. Similar Tool, with Blade solidly held.

thus raises or lowers the tool-holder contained in it to the proper height. All the members are clamped together and set by the tool-post screw.

The point of the blade may be fashioned as a turning tool, side tool, threading tool, etc. The device appears to be especially useful for threading on small work, where the center adjustment should be made with great care. The fact that the tool-holder itself can be rotated to any angle, may be taken advantage of in steep pitch screws to set the cutting tools at the proper angle to give equal top rake on both cutting edges. The device may also be conveniently used for centering drills, reamers, boring tools, etc., with the axis of the lathe.

THE APPLICATION OF MOTORS TO MACHINE TOOLS.

Dexter S. Kimball, in *The Sibley Journal of Engineering*, March, 1908.

The introduction of electrical distribution and the electric motor gave to engineers of large plants a solution to a problem that had for a long time been very troublesome. The old method of power distribution with its wide belts and large shafts was quickly recognized as far inferior to the new method of distributing power electrically, running the various lines of small shafting by motors belted to them. By an easy extension of this system the larger tools were soon belted to their own individual motors, and the advantages so gained were evident to all, and up to this point engineers were fairly well agreed. But engineers soon came forward with the claim that great economy could be obtained by attaching a motor to every tool, and doing away with all belts and line-shafts. On this point, however, opinions were not so unanimous, and a discussion arose as to the relative merits of the two systems, and many tests were made to determine which was the most economical way, these comparisons generally being drawn between the so-called *group system* and *individual motor system*. It was clearly shown that conditions exist where either or both systems have a place, and that again conditions may exist where neither are desirable, as in cases where heavy machinery is to be operated close to the prime mover. The plant must be very small and compact, however, when electric distribution cannot be used to advantage, and in large plants it is indispensable. It is also now conceded, by engineers in general, that large and portable tools can be best driven by individual motors.

That the individual drive has not met with more favor was due in the past mainly to two causes, *viz.*, imperpect motors, and the general attitude of machine tool builders. When motors were first introduced in this work, electrical designers had not studied the peculiar problems presented, and as a consequence the first motors were not very satisfactory. The machine tool builder, on the other hand, saw at once that the motor was going to impose a new set of conditions on these machines, compelling him eventually to alter his patterns; and many makers naturally did much to discourage what some of them characterized as a fad.

As might be expected, the combinations designed under these circumstances were fearful and wonderful. A standard gas engine fastened to an ordinary carriage would not make a very good automobile; yet in comparison it would show up well with some of these early efforts. These difficulties, however, are now being rapidly overcome, and it is possible to buy almost any machine tool, motor driven in some way, although not always in a very desirable manner.

The engineer confronted with the problem of connecting up his electrical system of distribution to his medium size and small machines will be governed largely by the following considerations in making his decision as to the method to be used: 1. First cost of installation. 2. Maintenance and depreciation. 3. Provision for extension. 4. Sectional operation. 5. Flexibility as to location of tools. 6. Efficiency of system. 7. Positive application of power.

It may be well to consider these points in detail.

1. Without question the first cost of individual driving is considerably greater than group driving, and unless it can be shown that the individual drive has great advantages in other ways which offset this important item, it should not be considered. This is often a very difficult thing to do, and first cost will remain a drawback to the motor drive for small tools till different conditions of manufacturing reduce the costs considerably from where they stand at present.

2. On the second point we have as yet not a great deal of data that the writer is aware of; but his experience has been that the cost of maintenance and the depreciation was somewhat less in group driving. In the group drive the great item of expense is that of belting, which is costly and wears out rapidly; on the other hand, when motors do need repairing the repairs are costly, so that, on the whole, there does not seem to be much choice. Reliable data on this point would be of great service.

3. Regarding the third point, the individual drive has all the advantage. No system has ever been devised that provides so easily for extension. Changes in arrangement are also more quickly and easily made with the individual drive.

4. Here, again, the advantage is all with the individual drive, particularly with large tools which may be required to run overtime. Further, the breaking down of an individual motor does not affect but the one tool.

5. On this point the individual drive has an advantage that is particularly important. Machines so driven can be placed wherever desired, and in case of large tools, ideal conditions are obtained for overhead handling devices. In the case of small tools, greater convenience can be obtained, and tools can be placed in the middle of the room without cutting out the light. Incidentally, the elimination of belts greatly decreases the dust.

6. It has been found by actual measurement that there is little to choose between group and individual driving as far as efficiency is concerned.

7. The seventh and last point is the one on which the individual drive has its greatest claim to superiority, and which has done more for the individual drive than anything else. It was soon found that where motors were directly geared to the machine, a greater output was possible on account of the elimination of the slip in the belt, and the consequent driving of the work up to the limit of the cutting tool. This, of course, greatly reduces the time of the operation, and, as the cost of the time is two-thirds the total cost of the product, it is easy to see what a saving could be effected. The introduction of the new high-speed steels added still more to the necessity of positive driving, and it has been well demonstrated that where heavy cuts are to be taken the positively geared motor will show a great saving of time over the belt drive.

Herein, also, lies the solution of the problem so confusing at present to the engineer who is trying to find out just how far he can carry the individual motor drive idea and make it pay. In the case of large tools it will be seen at once that the solution is plain, and a careful consideration will show that the individual drive can be successfully used down to

a point *where a belt of convenient size will have no trouble in driving the cutting tool up to its limit.* Rules which fix some particular limit to the minimum size of motor to be used, or the minimum size of machine to which a motor should be attached are very misleading, as it depends entirely on what the tool is intended to do. For instance, a group of 16-inch lathes in one shop may be required to only take off a very light chip, and a group drive is satisfactory. In another shop these lathes may do heavy work, so that a motor drive will pay handsomely. There is no trouble, as a rule, in driving small drill presses up to the limit of the drill by means of group drive, and these are driven successfully in this manner; the same being true of small tools in general. At present it will not pay, outside of the advantages of better light and cleaner surroundings, to drive very small tools individually.

Summarizing what has been said above, we may state our conclusions as follows:

	Group Drive.	Individual.
1. First cost	Considerably less	
2. Maintenance and depreciation	Probably less	
3. Provision for extension		Much superior
4. Sectional operation		Much superior
5. Flexibility as to location		Much superior
6. Efficiency of system	No great difference	
7. Positive application of power		Much superior

Having decided what tools to drive individually and what to group drive, the next question is the matter of motors and the methods of connecting them to the machines. Here, again, a great difference of opinion exists. In order to get a clear idea of what is needed in a motor for this work it will be well to look at the requirements of the tools themselves.

Machine tools may for this purpose be classified into the following groups:

(a) Machines requiring a constant speed. In this class come punches, shears, fans for ventilating purposes, and also the shafting of group drives. The torque may vary with the demand for power.

(b) Variable speed machines requiring maximum power at minimum speed. In this class are lathes, boring mills, and most machine tools where automatic regulation is needed. Here the cutting speeds are practically constant for a given metal, but the cuts are larger on the larger work.

(c) Variable speed tools requiring heavy starting torque, as cranes, sheet iron rolls, etc., where regulation of speed is by hand.

(d) Machines requiring a torque increasing with the speed, as blowers and fans which give variable blast. This class is rather unimportant.

Of course there is no trouble in meeting the requirements of the constant speed machines, but the problem of variable speed is difficult. If a good mechanical speed changing device were to be had, the problem would be easy to solve; but so far none has been produced that will answer the purpose. Many have been made that will give any speed between the limits of the mechanism, but they all depend on friction, and hence to carry the work required must in most cases be very large and cumbersome; while those that are positive in their action give only several speeds between the limits. Of the latter type a number are now on the market which can be used with success in many places.

When the electrical side of the problem is considered, a choice of two distinct systems of distribution is presented, namely, the alternating current, and the direct current systems, both of which have a place under proper circumstances in this work.

It may be said at the outset that when the alternating current system of distribution can be used, it is preferable, as the wiring is smaller in a large system, and the generators and motors simpler and more reliable. It has, however, its limitations, as will be seen, as far as machine tool driving is concerned.

The alternating current system offers two kinds of motors, the synchronous and the induction motor. The first is not self-starting and, except in a few cases, has no place in machine tool driving. Where heavy line-shafts are to be run for some length of time and provision can be made for starting, a synchronous motor is an excellent thing in connection with induction motors, as it tends to steady the line and help the power factor. In small sizes, however, it is not suitable for machine tool driving.

The induction motor is self-starting, and, like the synchronous motor, tends to run at constant speed. It is by its nature not a variable speed machine, although it can be made so in several ways, none of which, however, have so far proved adequate to the demands of machine tool driving. It has been successfully used on cranes and similar devices, the speed variations being obtained by putting resistance in the secondary, and variable speed induction motors are now on the market controlled in this manner. One plant at least has been fitted out with induction motors, where several changes of speed were obtained by varying the frequency, with fair success. But as yet, the induction motor cannot be considered as equal to the direct current motor for variable speed work, though considerable experimental work is now being done that may change the situation.

If the plant under consideration is to contain constant speed machines principally, the induction motor in connection with a mechanical speed-changing device will generally prove to be the best, and where all the machinery is of constant speed type it is much preferable.

The direct current system offers three kinds of motors, their combined characteristics covering much more closely the requirements of the case than do those of the alternating motor, and there is little doubt as to the greater adaptability of the system for general machine tool driving. These motors are: 1. Series wound motors. 2. Compound wound motors. 3. Shunt wound motors.

The series motor is a variable speed motor with great starting torque. It can be controlled throughout its whole range of speed and would seem at first glance to be almost ideal for lathes and boring mills. It is, however, very uneconomical, as the control is obtained by resistance in its circuit. It also requires an expensive controller on account of the heavy current to be handled and must be controlled by hand, as its speed varies inversely with the load, and under light loads it will run away. It is an excellent motor for cranes, elevators, sheet iron bending rolls, etc., and occupies a very important place in the equipment. It therefore covers the requirements of the tools under class (c).

The compound wound motor is suitable where small variations of speed are needed coupled with a large starting torque. It will, of course, give constant speed when set for any set of conditions within its range.

The shunt motor is, in its standard form, a constant speed motor. When set to run at a given speed it will not vary appreciably under varying load up to its capacity. It can be made to vary its speed in a number of ways, those which are most used being one of the following three: by varying the current in the armature; by varying the strength of the field; and by varying the voltage applied to the armature terminals.

These characteristics make the shunt wound motor most suitable of any for the purposes of machine tool driving and by means of these methods of control, either singly or in combination with each other or in combination with gearing, most of such work is now accomplished.

Summarizing the above conclusions, we may state them as follows:

Class of Machine.	Alternating Current Motors.	Direct Current Motors.
Constant speed torque varying with load.	Induction motor. Synchronous motor.	Shunt or Compound wound motor.
Variable speed, maximum work at minimum speed, automatic regulation.	Induction motor with mechanical speed changing device.	Shunt wound motor with or without change gears.
Variable speed. Heavy starting torque. Hand regulation.	Induction motor.	Series wound motor.
Variable speed, torque increasing with speed.		Comp. wound motor.

FRENCH COMBINED HORIZONTAL AND VERTICAL MILLING MACHINE.

La Machine Moderne in the issue of January 1, 1909, described a new milling machine recently brought out by the Société Francaise de Machines-Outil, the new French machine tool building firm of which we have made mention from time to time. Like the Ingersoll combined horizontal and vertical milling machine (described in the new tools department of the March, 1908, issue of MACHINERY), this tool is provided with two spindles, one vertical and the other horizontal, which may be used separately or simultaneously, though there appears to be no provision made for axial adjustment of the spindles.

"One of the refinements much sought after in the construction of milling machines is a combination of two spindles, one vertical and the other horizontal, permitting the easy transformation of the machine from a vertical to a horizontal miller, or *vice versa* as occasion requires.

"Different solutions of this problem have been offered. Among others, certain American builders make an attachment carrying a vertical spindle, which can be mounted on the horizontal spindle; but when so used the horizontal spindle is out of commission. Furthermore, each change in the method of operation necessitates the mounting or dismounting of the attachment, which, in order to be portable, is generally of light construction.

"To escape these inconveniences, the Société Francaise de Machines-Outils has designed the machine shown in Figs. 1 to 8, which only requires a simple rotation of the vertical head to change from vertical to horizontal milling. It should be noticed also that when the vertical head is turned back out of the way it presents a particularly strong support for the arbor in the case of horizontal milling. Among the different kinds of machine tools, in the design of a milling machine especially should a new company take account of the established reputation of certain foreign makes at present on the market, and of the difficulty of turning in its own direction the prejudices of the French consumer. The builders have, therefore, laid out a definite catalogue of the desirable qualities of such a machine, which can be summed up in the following list: First, rigid construction; second, easy manipulation; third, silent and positive drive; fourth, single drive for the spindle and the feeds; fifth, change of feed independent of the change of speed of the spindle; sixth, a large number of spindle speeds and rates of feed; seventh, large bearing surfaces; eighth, careful workmanship.

"The drive, which is of the single pulley variety, transmits to the spindle 16 speeds in geometrical progression, by means of trains of gearing shifted by a hand-wheel, whose eight positions each give eight speeds; these can be doubled by the operation of a lever whose central position stops the machine. The speeds are indicated on a dial in full view of the operator. The proper speed for the spindle can be found by consulting a diagram furnished by the builders. All the mechanism for changing the speeds is contained within the column, and the different speeds are applicable both to the horizontal and vertical spindles. The vertical spindle can be disengaged when it is not desired to use it.

"This machine is furnished in the plain and universal forms —that is to say, with or without a swiveling table. The table is carried by a cross slide or saddle, which is supported on a strong knee, sliding vertically on large bearings at the front of the column.

"The feed mechanism is constructed with a change gear device similar in construction to that of the speed change—that is to say, 16 feeds can be obtained by the manipulation of a hand-wheel and levers, as seen in the illustration. The feeds, horizontal, cross, and vertical, are independent of the spindle and are reversible. The drive of the feed gear box is derived from the main drive. The different movements have automatic stops throughout in all directions, as well as positive stops for hand feeding. All the feed screws are provided with graduated dials. The knee, as well as the saddle and table, can be locked in any position by screws independent of the gib screws. A safety coupling is provided to prevent the breakage of important parts in the case of abnormal stress.

"The screw for the vertical adjustment of the knee is of the telescopic form, to obviate the necessity for cutting an opening in the floor. Especial care has been taken in the lubrication of the working parts within the column. The driving and feeding mechanisms, all of the bearings therein contained, and those of the spindle, are oiled by a pump which draws its supply from a reservoir in the base of the machine. The supply of lubricant for the cutters is furnished in a similar way, by means of a second pump and reservoir, separate from the first.

"Mention should also be made of the care taken to have all the mechanism accessible, for the sake of facility in cleaning and repairing. The engravings shown herewith (Figs. 3 to 8) show clearly the variety of work to which the swiveling head lends itself, including as it does, the particularly interesting operation of helical milling on a plain machine. This machine is being built in several styles and sizes."

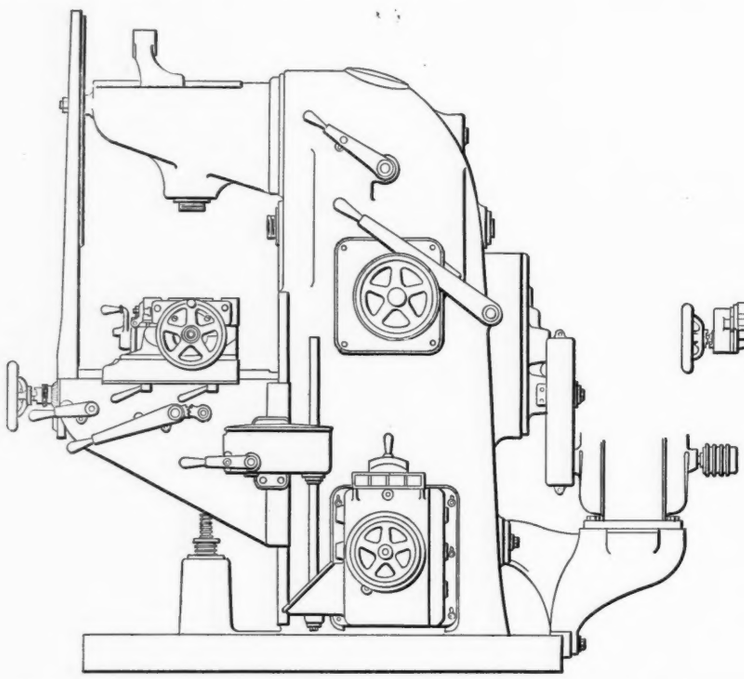


Fig. 1. Side Elevation of Combined Horizontal and Vertical Spindle Milling Machine, made by the Societe Francaise de Machines-Outils.

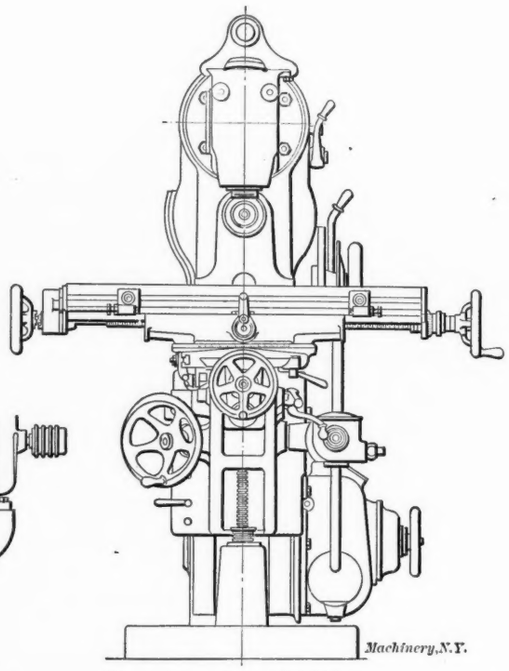


Fig. 2. Face View of Machine.

STRESSES IN WIRE ROPES DUE TO BENDING.

Abstract of Paper by R. W. Chapman, in the Proceedings of the Australasian Institute of Mining Engineers.

Unwin states that a wire rope used over a pulley or sheave is subjected to three different stresses. Firstly, there is the longitudinal tension due to the weight suspended by the rope and the weight of the rope itself; secondly, the tension and compression stresses in the part of the rope resting on the pulley, due to the bending of the rope in a curve; and in the third place, there is a stress due to the centrifugal action at that part of the belt which is bent over the pulley. This last stress, of course, can be disregarded whenever the speed with which the belt moves over the pulley is moderate. The author of the paper here abstracted examines in detail the stresses due to bending only.

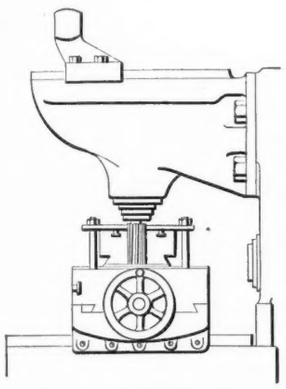


Fig. 3. Machine arranged for Plain Vertical Milling.

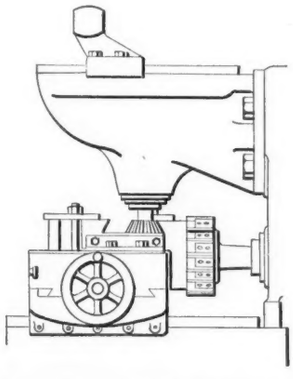


Fig. 4. Machine using Vertical and Horizontal Spindles Simultaneously.

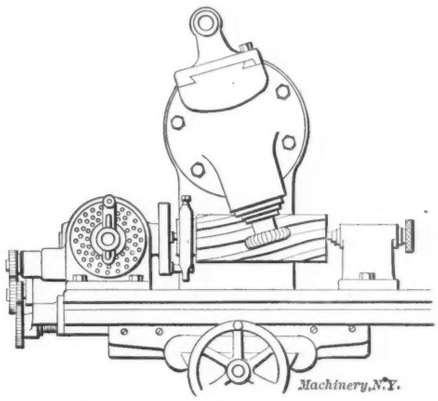


Fig. 5. Vertical Head Swiveled for Helical Milling.

The difficulties met with by investigators in trying to ascertain exactly the stresses in wire ropes bent over sheaves, is due to the fact of the complex structure of the wire rope, being made up, as it is, of spirally twisted strands, which in turn are composed of spirally twisted wires, it being difficult to say exactly what happens when this doubly twisted structure is wound around the drum or sheave. The difficulty is generally evaded in ordinary practice by the simple device of adopting a large factor of safety for a rope, usually one from eight to ten, a factor which experience has shown is sufficiently large to cover the bending strains set up when the rope is passed over sheaves of ordinary size. When, however, we add the stress due to the bending of the rope to the stress produced by direct pull, we find that the actual factor of safety is usually more nearly four than ten, and often the bending stresses in the rope are so large compared with the simple tensile stresses that neglecting them may lead to disastrous results.

Empirical Rules for Size of Sheaves.

It has always been recognized that the bending of a wire rope over too small a sheave injures the rope, but as it is also desirable to reduce the size of the sheaves to a minimum for constructional reasons, the diameters of the sheaves are commonly made as small as is considered permissible. Various empirical rules have been given by different makers and writers for determining the minimum size of drum over which a rope may be wound. One maker states that the diameter of sheaves and drums should be about 30 times the circumference of the ropes used. Another rule says that the diameter of the sheave in feet should be $0.7C^2$, where C is the circumference of the rope in inches. Mr. H. W. Hughes in "Text-Book of Coal-Mining" states that the diameter of the pulley should not be less than 100 times that of the rope wire. Another writer gives the rule that there should be one foot diameter of pulley for each ⅛ inch diameter of rope; or, for instance, an 8-foot pulley for a one-inch rope. All these rules, however, are imperfect, because they take no account of the size of the component wires, and from practical experience we know that the smaller the diameter of the wires, the more flexible is the rope and the smaller may be the diameter of the sheave over which it may be bent.

A rule, to be of any reasonable value, should take into account the gage of the wire composing the rope. Such a rule is given by Mr. Bucknall Smith, in the *Mining Journal*, June 6, 1896, where he states that the diameter of the smallest pulley permissible should be at least 800 times the gage of the wire used. J. B. Richards, in *Mines and Minerals*, April, 1904, however, states that records show that the proper diameter of a sheave should be 115 times the diameter of a rope having 19 wires to a strand, and 185 times the diameter of a rope having 7 wires to a strand. Finally, another rule is given, deduced from practice, stating that a 6-strand, 7-wire rope requires a pulley whose diameter is equal to ten multiplied by the rope circumference squared; and a 6-strand, 19-wire rope requires a pulley whose diameter is equal to four multiplied by the square of the rope circumference. It will be noticed that there is a considerable variation of opinion expressed in the above rules, and while they may be useful for deciding approximately upon what experience has shown to be the proper size of pulleys to use for a given class of rope, they do not aid in determining the actual stresses placed on the rope by bending over pulleys of any given diameter.

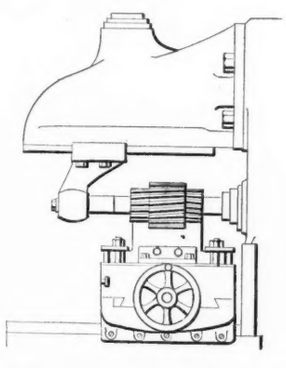


Fig. 6. Vertical Head Reversed to provide Outboard Support for Arbor in Horizontal Milling.

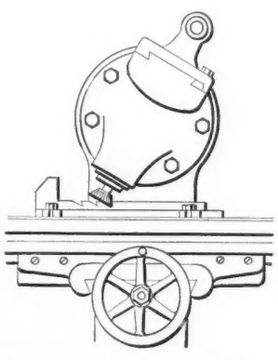


Fig. 7. Head Swiveled for Angular Milling.

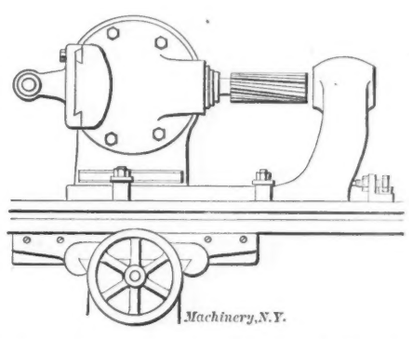


Fig. 8. Head Swiveled to Horizontal Position for Reaming, etc.

Formula for Stresses in Wire Ropes due to Bending.

The author of the paper here abstracted therefore sets out to deduce mathematically a formula, giving the stresses caused by bending ropes over sheaves of given diameters, and he comes to the conclusion that the stress in pounds per square inch set up in a wire rope equals

$$\frac{E\,d}{D}\cos^2\alpha\cos^2\beta$$

in which formula

E = modulus of elasticity of material, from which the wire is made,

d = diameter of component wire, in inches,

D = diameter of sheave, in inches,

α = angle made by the component wires with the axis of the strand, usually about 18 degrees,

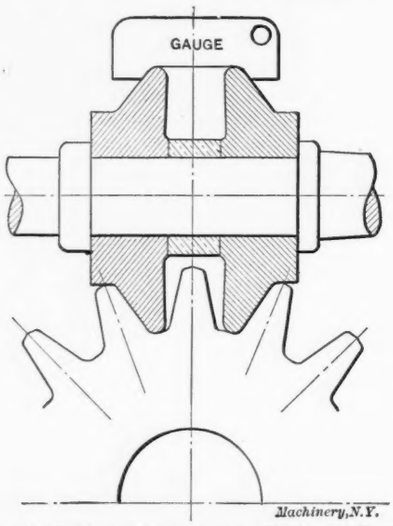
β = angle made by the strands in the rope with the axis of the rope, usually about 18 degrees.

[It will be found that the values obtained by the use of this formula are considerably greater than those obtained by Mr. James F. Howe in the article on "Bending Stresses in Wire Rope" in the June, 1907, issue of MACHINERY, engineering edition. The difference is due to the fact that Mr. Howe simply assumes a rather low constant modulus of elasticity for the rope as a whole, while the author of the present paper introduces the actual angles made by the wires and strands, thus, it would seem, arriving at a more definite and correct result.—EDITOR.]

* * *

CHAIN DRIVES.

The advantages of chain drives as compared with belt drives, for certain service have frequently been pointed out. The chain drive is positive, and high tension of the chain is not required to make it grip the sprocket, as in the case with belts on pulleys. There is, therefore, an entire absence of slip, and the power is used more economically. Chain drives can also be made to occupy less space than a belt drive, and



Testing the Setting of the Cutters for Cutting the Teeth in a Renold Silent Chain Gear.

give efficient service at center distances too short for belts but too long for gearing. The troubles met with in belts in hot or damp places, are also well known to all mechanics. These difficulties are eliminated in the chain drive. One objection to chain drives has been that they are noisy, but the noise can be largely obviated by properly designing the chain and the sprocket. The size of the sprocket is a question which influences the noise of the drive. Other things being equal, the smaller the number of teeth, the greater the noise made by the drive. The action of the chain is smoother and more uniform on a large sprocket than on a small one. This principle applies to all chain gearing and should be taken into consideration when laying out a drive. In extreme cases a sprocket with only seven or eight teeth may be used with a roller chain, but eleven or twelve teeth should be considered as the minimum in all cases where smooth running is essential. Generally, even the best designed driving chains, such as the Renold silent chain, should not run more than 1,250 feet per minute. When this limit is passed some special means of lubrication should be adopted. The roller chain is generally used for speeds from 600 to 900 feet per minute, and the block chain for speeds up to 600 feet. When designing a chain drive, inclined or horizontal positions should be chosen, with the tight side of the chain on the top.

In the accompanying Data Sheet Supplement, formulas are given for obtaining the various quantities in regard to length of chain, diameter of sprocket, etc., required in determining upon a chain drive, both for the Renold silent chain, the roller chain and the block chain. The highest ratios desirable between the driving and driven sprockets are, for the silent chain, 1 to 6, and for the roller and block types 1 to 7½. The maximum and minimum number of teeth advisable are for silent chain 15 and 90, for roller chain 8 and 70 and for the block chain 6 and 60. The pitch of the chain is measured from center to center of rivets, the pitch of the wheel being approximately at the tops of the teeth. An odd or "hunting" tooth should be used in the pinion when possible in order to distribute the wear evenly on the sprocket teeth. It is advisable to have the center, on which one of the sprockets is mounted, adjustable, in order to be able to keep the chain at the right tension.

Ordinary chain drives should be lubricated at least once a week, and the lubricant should be free from any tendency to gum. A thin oil may be used first to penetrate the joints, and then a thicker oil that will not be thrown off by the centrifugal force. The lubricant is best applied with a brush to the inner side of the chain while running the chain slowly on its sprockets. The chain should be lubricated oftener than once a week when used under severe conditions, as in the case of constant running night and day, fluctuating loads, when running in dusty places, etc.

It is interesting to note the manner in which the teeth in the sprockets for the Renold silent chain are cut. The tooth space is first cut from the solid blank by a stocking cutter. The teeth are then finished by cutters working in pairs, as shown in the accompanying illustration. For the same pitch three different pairs of cutters are required. These cutters are very nearly the same in form, the only difference being that they make the tooth slightly deeper for the smaller wheels. The cutters are set to a gage, as indicated in the illustration. The center line of the gage should be set exactly central with the sprocket to be cut. When cutting steel or phosphor bronze, and especially if the teeth are cut from the solid directly by the finishing cutters, it is advisable to set the dividing head so as to cut alternate teeth, or even teeth further apart than every second tooth, the inaccuracy due to local heating being thereby avoided.

Tables will also be found in the Supplement for malleable chains as made by the C. O. Bartlett & Snow Co., Cleveland, O. A table is also given for the shape of the teeth in the sprockets, for the various numbers of chain.

* * *

The following case-hardening mixture is recommended in the *American Engineer and Railroad Journal*. Put in a two-inch layer of charcoal, broken into about one-inch pieces, and pack it down in the bottom of the box used for the case-hardening. Then sprinkle about one pound of common salt over the charcoal, and one pound of pulverized sal soda over the salt. Then one pound of powdered resin is placed over the sal soda, and one pound of black oxide manganese over the resin. The material to be case-hardened is now laid on this, care being taken not to place the pieces too close together or too close to the sides of the box. Between the pieces, charcoal is filled in and well packed, care being taken to have about two inches of charcoal between the different pieces, if they be large. Now the sprinkling of the compounds on the work is repeated in reverse order, so that a two-inch layer of charcoal is placed on the top of the box. Sprinkle a little salt on the top of the charcoal, then put the cover on the box, calk with clay, and place the box in the furnace from ten to fifteen hours, heating it to a bright red. Then cool it in cold, clear water.

ELECTRICAL WELDING.

In a recent issue of MACHINERY (October, 1908) was shown a photograph of a number of examples of high-speed steel tools electrically welded in the shops of the Thomson Electric Welding Co., of Lynn, Mass. Little or nothing was said about the process itself or the range of its application. This article has been prepared in the belief that there is enough of interest and importance in electric welding to make a more detailed description of it profitable. While the process was invented several years ago, improvements are constantly being made in its application.

Fig. 1. Welding a Steel Ring in a Hand-power Machine; Section, 1 1-2 x 1-16 inch; Current, 10,000 Watts per 1 1-2 second.

The Principle of Electrical Welding.

The process consists, primarily, in holding the pieces to be welded between clamps, which form the terminals for an electrical circuit of very high amperage. When the surfaces

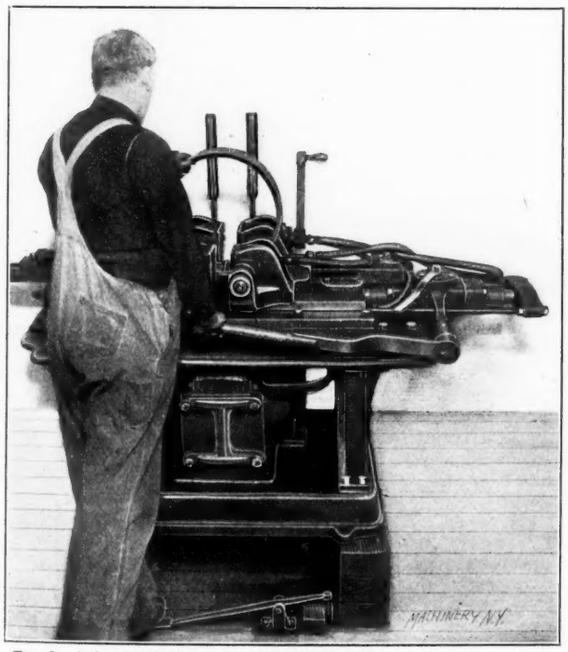


Fig. 2. A Large Machine, operated Hydraulically. Section welded, 3 x 5-8 inch; Current, 70 K.W. for 50 seconds.

to be welded are brought into contact with each other, these parts, themselves, complete the circuit, the current being transmitted directly through the work. The current strength is such that the resistance to its passage at the point of contact generates a welding heat. If the surfaces are not finished so that they come squarely into contact with each other, the reduced conducting section where the contact is made will heat rapidly to a high temperature, and flow, allowing the two parts to be pressed together into closer contact, until the whole area is at a welding heat. The heating action is thus progressive, being generally from the inside of the metal out, instead of being from the outside in, as with all other heating processes.

Simple Welding Machines for General Use.

A simple type of machine for this process, adapted particularly to the welding of hoops, is shown in Fig. 1. The machine consists of a transformer; the electrodes between which the two ends of the work to be welded are clamped; means for pressing together the surfaces to be welded; and the necessary electrical connections, switches, etc.

The purpose of the transformer, which is mounted in the base of the machine, is to change the high potential alternating current as it is received from the shop dynamo or the commercial circuit, to the low potential, high amperage current required for welding. As it is the strength of the current in amperes that taxes the capacity of the conductor, it is necessary to transform the current into one of high amperage (and consequently low voltage) in order to over-tax the conductor at the point where it is to be heated to the desired temperature for welding. The two secondary terminals of this transformer form the support for the clamping device in the jaws of

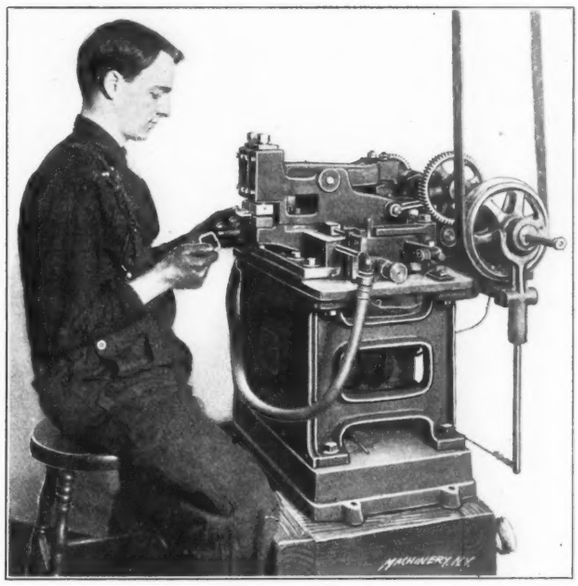


Fig. 3. A Small Automatic Machine for Welding Belt and Harness Buckles, etc.

which the ends of the hoop to be welded are held. Each of these jaws is clamped to the work by cams operated by the handles shown projecting upward at the top of the machine. The two jaws are, of course, insulated from each other, so that the only path for the current is through the work.

The lever at the right hand of the operator is used for pressing the two ends of the work together. The current being thrown on, heat develops at the point of contact, owing to the high resistance to the passage of the current found there. As these points of contact are softened, the continued pressure applied by the workman forces the parts closer together, bringing them into more intimate contact. The heat developed finally so softens the work that its resistance to the pressure applied by the operator is suddenly relieved, the soft metal being squeezed out from between the joints as the jaws come together. It is important at this juncture to shut off the current immediately, to prevent over-heating and burning. This is done by an adjustable micrometer stop which, by making an electrical contact and energizing a magnet, throws open a switch in the primary circuit. The clamps are then loosened and the work removed. These various operations are matters of seconds only, and on work of me-

dium size the output is practically limited only by the rapidity of the operator's movements.

The machine just described might be spoken of as being, in a measure, a general purpose machine. Another general purpose machine for larger work is shown in Fig. 2. This is adapted either to the welding of hoops, as shown in the engraving, or the welding together of rods, bars, and general machine parts. It is adapted to work so large as to make direct hand operation impracticable for pressing the two ends of the work together. For this reason a hydraulic

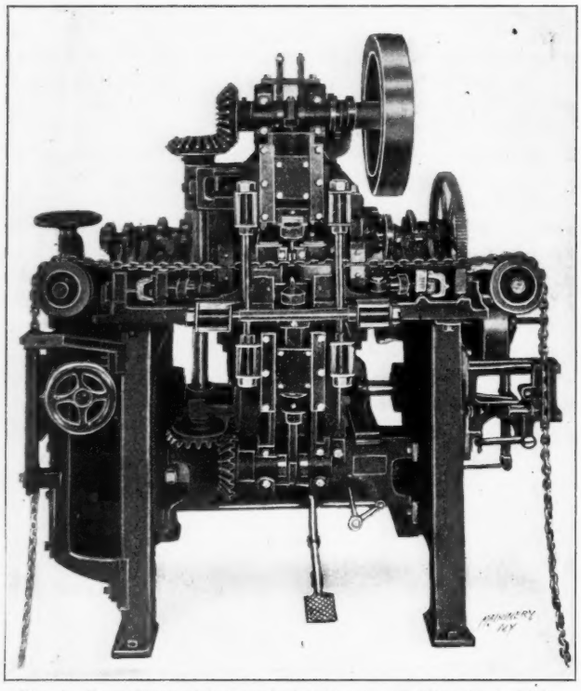


Fig. 4. Front View of Automatic Machine for Welding Chain Links.

jack is incorporated in the machine. The workman is shown with his right hand grasping the pump lever of this jack. The release valve is seen mounted on top of the cylinder. The clamping jaws are each operated by two levers, one for opening and closing them through a considerable range of movement, and a second one for firmly tightening the work under great pressure. A fixed stop is provided on an extension arm at the left to furnish an abutment for the work against the pressure of the jack when welding bars, rods, etc. In this machine, owing to the size of the sections to be welded, the heating action is somewhat slower, so that the operator can throw off the current with the foot switch shown, when the pieces reach a welding heat. In the case of the small work used on the previous machine, the heating is so rapid that the switch has to be thrown automatically to prevent burning the metal. In both of these machines the parts in contact with the work are water cooled.

Advantages and Disadvantages of the Process.

For work to which it is applicable (and its range of work is surprisingly large) the electrical welding process presents certain well-defined advantages. In the first place, as has been described, the heating is from the interior of the work out, instead of from the exterior inward, as is the case with any outside application of heat by coke fire, gas furnace, or similar means. This gives assurance that the whole section will be properly heated and properly welded. This is not possible in the case of large sections heated from the outside. Uniformity of heating is assured by the fact that if at any point the temperature is higher than at other points of contact between the parts, the increased heat increases the resistance, forcing the current into the cooler sections, and thus equalizing the temperature until it is uniform throughout the whole area. The process is almost instantaneous on small sections, and on larger work requires but the merest fraction of the time required with the old processes. The metal, while heating, is in the full view of the operator, instead of being concealed by flame or fuel. The weld is homogeneous, being of the same material throughout, uniting in intimate contact. By suitable electric controllers the metal can be held at any temperature desired for any length of time, and the heat increased and decreased as well.

The method applies to a great range of kinds and forms of metal, including those which could not hitherto be effectually brazed. Metals of widely dissimilar character can also be united. The process is under close control, so far as accuracy of dimensions is concerned, owing to the fact that the parts are kept in accurate alignment by the clamps, which may be given any shape necessary to hold regular or special work. Another point of importance is the extreme economy in the use of heat. This is localized at the point desired, and very little of it is lost by radiation, or is used in heating anything else except the work. The apparatus is clean and free from dust and dirt in its operation. There is, as well, no blistering or scaling of the work, the heat being confined to the welded joint. The slight fin or swelling produced at the junction may easily be broken or ground off, leaving a smooth, flawless surface. The current may be generated by dynamos, specially designed for the purpose, installed in the shop, or may be taken from a city light supply, if the latter is of the alternating current type, at from 100 to 400 volts.

The disadvantages which might be mentioned in connection with the process are chiefly those which are closely connected with the advantages. One of them is the great rapidity of action of the machine, which would tend to keep it idle the greater part of the time, except in shops where there are great quantities of welding to be done. For firms which have a moderate amount of work of this character, it is best to send their work to companies making a specialty of the process, rather than to install the necessary machines. Another point that might perhaps be considered as a disadvantage, is the fact that special electrodes or clamping jaws are required for many forms of work, whereas welding in a forge requires only tools of universal application and of the simplest kind. The holding jaws required for electrical welding, however,

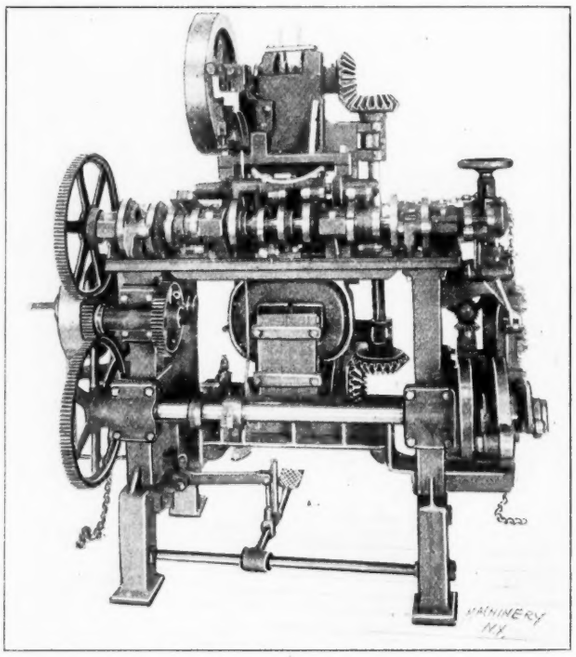


Fig. 5. Rear View of Chain Welding Machine.

are very simple, being in their nature something like the special chuck jaws often used for holding work in milling machine vises.

Automatic Machinery for Electrical Welding.

One of the noticeable features of this method of welding is its applicability to special work. The Thomson Company builds special machinery, some of it of a high degree of complication, for manufacturing a wide range of metal products. We show two or three examples of such machinery. In Fig. 3 is illustrated a machine intended to be used in such work

as welding belt and harness buckles, rings, etc. It is exactly identical in its operation with the machine shown in Fig. 1, except that the clamping and the pressing together of the ends of the work is effected by cam movements. The throw-out of the current is automatic, as before. The switch is thrown in again by a cam instead of by hand. The clamps are water cooled. In making each weld, 3,000 watts are used for a second. All the boy has to do is to feed in the buckles, which drop out of themselves after being welded.

Figs. 4 and 5 show front and rear views, respectively, of a highly complicated chain welding machine. This machine simply welds the joints, the chain having been formed, assembled and closed by automatic machinery. It is fed through the clamps or dies by the hand of the operator, all of the other movements and the control of the switch being automatic as in the previous case.

Another special application is in the making of wire fencing, and wire mesh for reinforcing concrete. In this case cross wires are automatically laid on strands of continuous wire, spaced suitable distances apart and firmly joined to them by welding at the points of junction. This makes a fence which is in its completed form one solid piece, instead of being held together by twisting the wire or soldering. The operation of "spot" welding is employed in many cases for joining sheet metals to each other, such as for fastening handles, spouts and other attachments to cooking utensils, etc. In this case it takes the place of riveting. The two metals are joined together under the contact points, being fused into homogeneous contact.

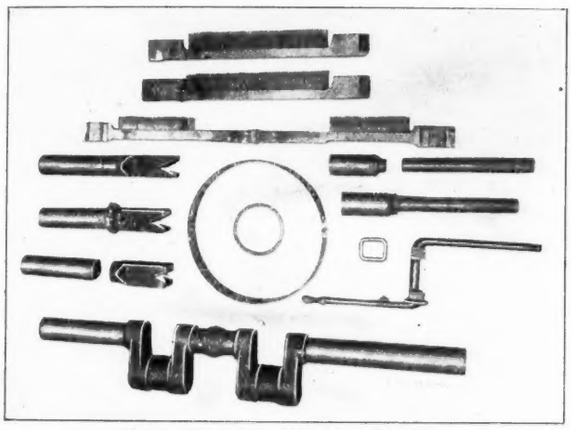


Fig. 6. Examples of Electrical Welding.

Fig. 6 shows a number of examples of the work produced by this process, which will serve to give some idea of its range. The three upper pieces are combs of a kind used in working wool. In the machines in which these are used, the hard service given them crystallizes them and causes them to break. They are easily repaired by adding new ends, or (in the case of the double ones) by rejoining them together at the middle. This can be done by this process and still keep the piece to accurate dimensions. The tools shown at the left are used for stone cutting in pneumatic or steam hammers. The breakage of these pieces is another case of crystallization under continued impact. They can be repaired, as shown, by welding the broken pieces or by putting on a new soft steel shank, at a fraction of the cost of forging and forming a new tool of high carbon steel. The two hoops in the center are similar in character to the work shown in progress in Figs. 1 and 2. The counterbore blanks at the right are similar to the work shown in the article in the October issue. A harness buckle and a welded bicycle crank are also shown. The large two-throw crank was built up from commercial forgings. It is possible to use these in building two, three, four, or other multiple throw cranks, with the throws set at any desired angle with one another, thus making costly special forgings unnecessary.

This process of electrical welding is controlled by the Thomson Electric Welding Co., which is prepared to do jobbing work, to lease standard machinery, or build special machinery, as may be required for doing work of any kind that can be done by this method.

BROACHING A DOVETAIL KEYSEAT IN A TAPER HOLE.

T-SQUARE.

It was desired to broach a dovetail keyseat in the crank-shaft hole of a large quantity of bicycle cranks. The cranks were of nickel steel and had a 10-degree taper hole, with a minimum diameter of 17/32 inch, to be broached to receive a flat key, 3/8 inch wide by 1/16 inch thick, dovetailed to a 10-degree included angle. When the keys were driven into place in the cranks, the latter were required to be interchangeable on the crank-shafts, which were slabbed off on one side of the taper end to correspond with the key in the crank, and fitted with an ordinary check-nut to retain the crank.

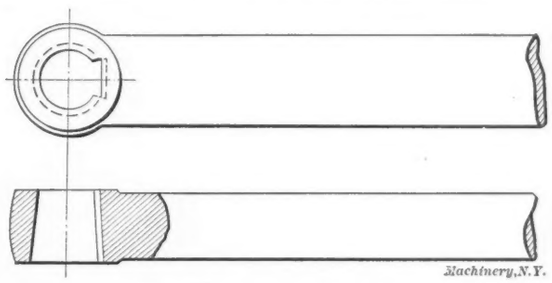


Fig. 1. View of the Broached Work.

To fit a key in this manner and insure interchangeability and a simultaneous fit on both key and crank, requires a nice degree of accuracy; and considering this, and the toughness of the steel, as well as the necessarily limited diameter of the broach, it was expected that the operation would prove expensive. Subsequent experience with the use of the device here illustrated, however, proved otherwise, as thousands of the parts were broached most successfully at a remarkably small cost. Fig. 1 shows the piece to be broached. Fig. 2 shows a machine steel plate, planed on the bottom and sides to fit the die-bed of an ordinary 8-inch stroke drawing press, and planed on the top to an angle of 5 degrees. After the planing operation a hole was bored at right angles with the top surface, to receive a tempered guide bushing *A*, which was pressed into place. The guide hole for the broach was then put through at right angles with the bottom of the plate. Thus it will be seen that when the crank is placed in position over the guide bushing and brought into contact with the stop pin *B*, the surface to be broached will be parallel with the line of travel of the broach.

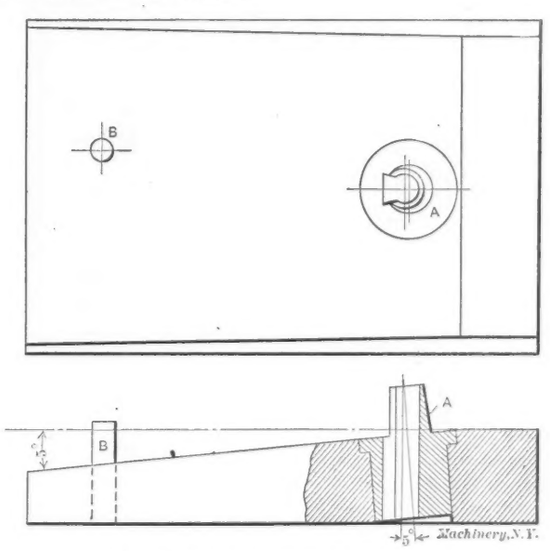


Fig. 2. Fixture for Holding the Work.

Fig. 3 shows one of a series of three broaches which are required to complete the cut. These are made to slide freely through the guide bushing *A* (Fig. 2), and are held in the proper position in the holder *D* by means of a locating piece *C*. As the press reaches the limit of the downward stroke, the broach, which has ceased cutting, simply drops through

the bushing into the hand of the operator, who then inserts broach number 2 into the holder as the press reaches the upward limit, thus making it unnecessary to stop the machine to insert the tools. Great care should be experienced to keep the teeth of broaches of this kind free from chips, which can easily be accomplished by the operator passing his fingers downward over the face after each removal from the guide bushing, and before depositing in the pan of oil.

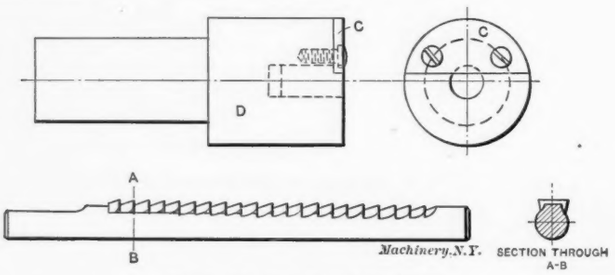


Fig. 3. The Broach and its Holder.

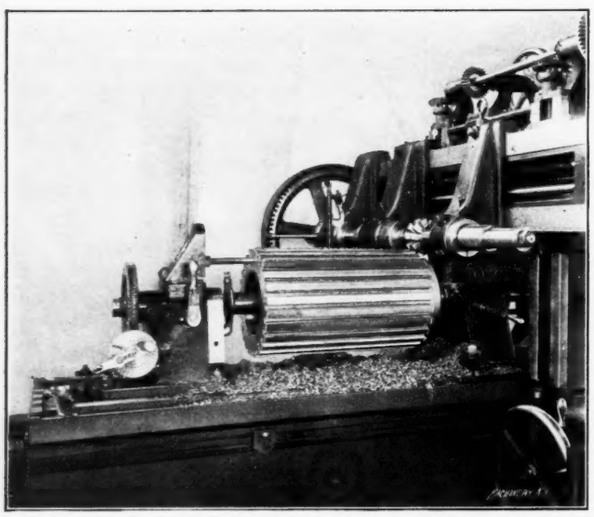
In tempering broaches of the shape used in this operation, the best results can be obtained by slowly heating the piece, face downward, in a charcoal fire. When heated face upward, the piece will invariably bend, making the face concave, and as they require to be reasonably hard, it is a difficult matter to straighten them.

* * *

CUTTING A LARGE SILENT CHAIN PINION.

C. M HAMERSLY.*

At the Link-Belt Co.'s Philadelphia plant the problem of cutting 26 teeth of 2-inch pitch in three forged steel blanks each 16½ inches diameter, 27 inches face, with a hub on one end 14¾ inches diameter by 2 inches wide, making a total width over all of 29 inches, proved too much for the automatic gear machines, owing to the exceptionally long face.



Cutting Long Face Pinion for Renold Chain on Slab Milling Machine.

The difficulty was finally solved by performing the operation on a Bement, Miles & Co.'s 24-inch horizontal slab milling machine, using a pair of heavy index centers constructed by the company, especially for this class of work. The illustration shows the blank after it had been stocked out, and with the finishing cutter forming two teeth at the same time. In cutting the teeth 350 pounds of metal was removed. The blanks weigh 850 pounds each, and have a 10-inch bore.

These pinions form part of three silent chain drives of 350 H. P. each, that are to transmit power for a wire-drawing bench at a plant of one of the large steel companies, each drive consisting of a wide-face pinion connected to two large gears by two strands of 2-inch pitch Renold silent chain, each strand 12 inches wide.

* * *

The reason why men who mind their own business succeed is because they have so little competition.

* Address: Link-Belt Co., Nicetown, Philadelphia, Pa.

INCLINED PLANE SHOP CAR ELEVATOR.

The accompanying half-tones, Figs. 1 and 2, and the line engraving, Fig. 3, illustrate an interesting appliance installed in the shops of the firm of H. Bollinckx, 117 Chausée de Mons, Brussels, Belgium. There is a difference in the level of two departments in the firm's works, and some difficulty and loss

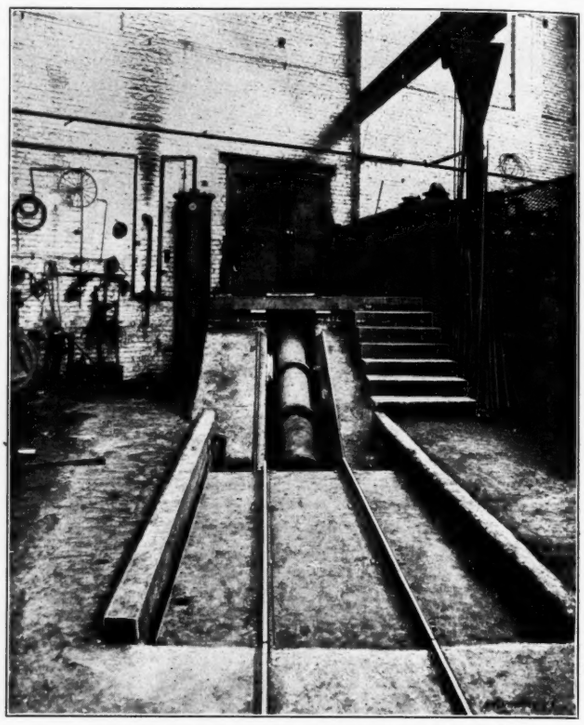


Fig. 1. Shop Car Elevator at Lower Level of Travel.

of time was experienced in transporting material from one to the other. Due to the fact that the work was of a varying nature, and some of the pieces to be transported very long, the ordinary elevator did not suit for bringing the material

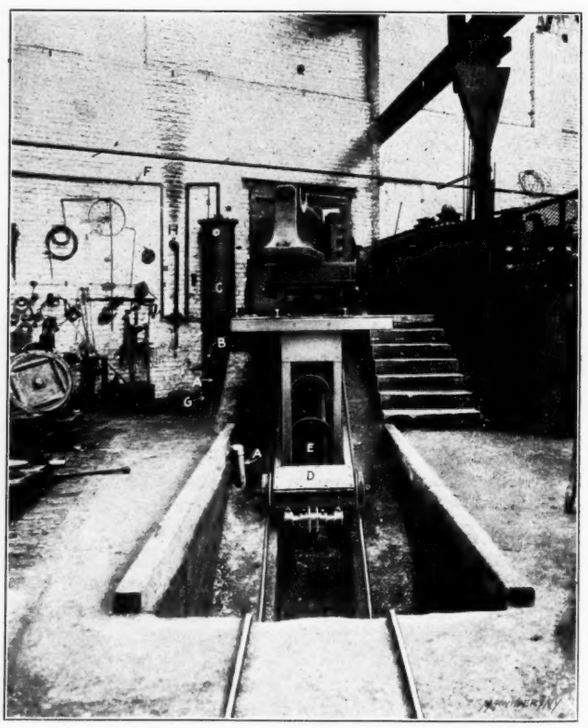


Fig. 2. Inclined Plane Shop Car Elevator at Upper Level of Travel.

from the lower to the upper level, or *vice versa*. For this reason, an inclined plane car was installed on which the regular shop cars could be placed and raised or lowered to the levels of the different shops, as required. The platform of the inclined plane car is provided with rails for this purpose, as

shown in Fig. 1, where the car is located at the lower level of its travel. In Fig. 2 the inclined plane car is shown in its upper position, level with the floor in the other shop, and with a shop truck, loaded with a casting, on it. The platform of the inclined plane car is supported by a framework *D*, mounted on wheels and traveling on an inclined track. The power for the motion of the car is transmitted to it through the cylinder *E* which is filled with water and is connected with the tank *C*, shown at the left-hand side of the upper platform. The tank *C* is connected with the compressed air system of the shop by the piping *F*, thereby obtaining the required pressure on the water. The piping *A* connects the tank *C* and the cylinder *E*, and the valve *B* on the piping *A* is provided so that the inclined car can be made to stay wherever it is stopped. This is very important in order to prevent the car from sliding down again when it has arrived at the top level. When the car is again required to descend, the compressed air is let out at *H*, the valve *B* between the cylinder and the tank is opened, and the car descends in about thirty seconds. The valve *B* is opened by raising the counterweight *G* on the lever of the valve. When the inclined car has reached the lower level, the operator simply drops the counterweight, and the valve is shut automatically. At this time the air valve may be again opened so that the water in the cylinder *C* is under pressure, ready for the next lifting of the car to the upper level. The valve *B* being shut, the pressure cannot be transmitted from the tank *C* to the cylinder *E* before the valve *B* is again opened. The pressure of the air is kept at about seventy to seventy-five pounds per square inch. This gives a total lifting power of 22,000 pounds.

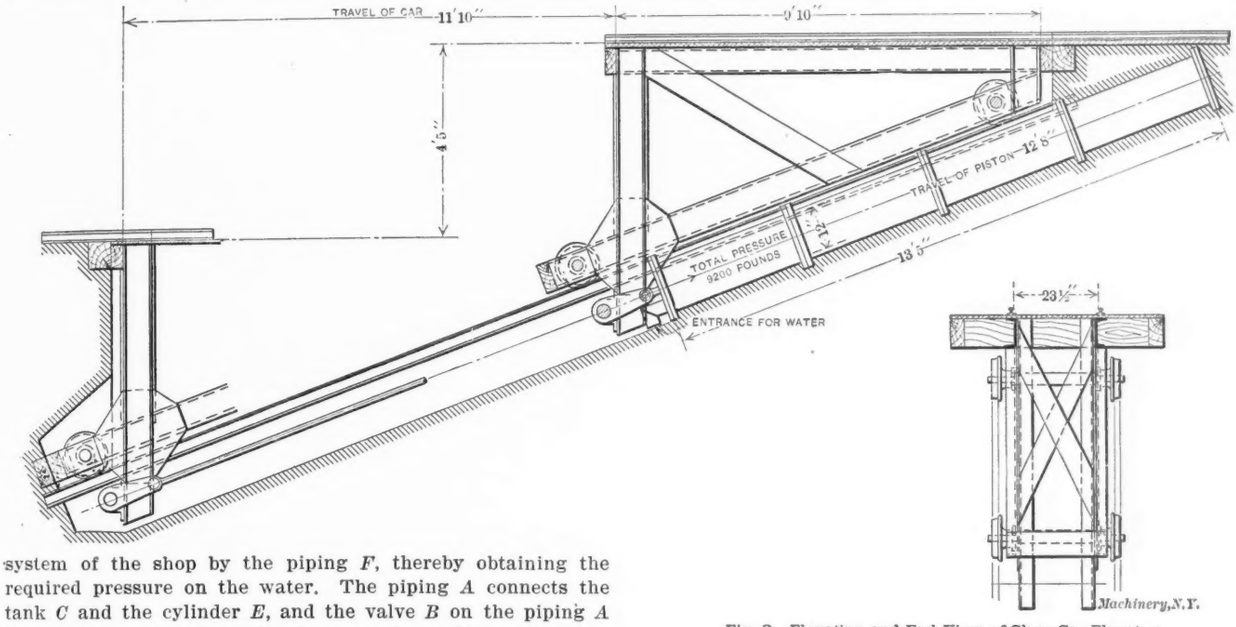
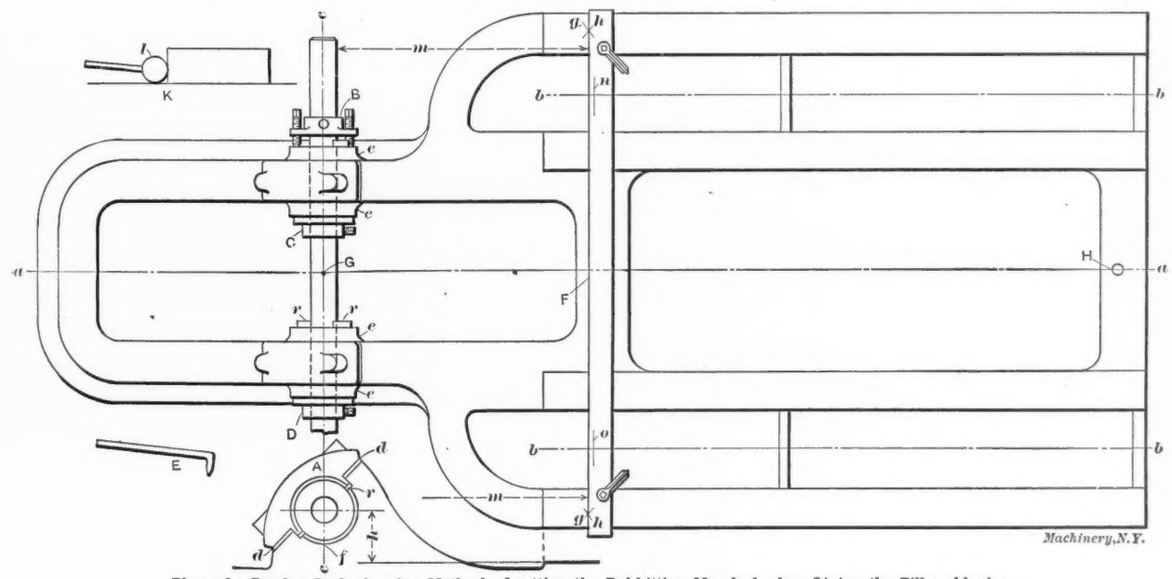


Fig. 3. Elevation and End View of Shop Car Elevator.

MACHINE SHOP PRACTICE.*

BABBITTING THE PILLOW-BLOCKS OF A DUPLEX BED.

Babbitt metal is used very extensively on many kinds of machinery as a lining for the bearings, instead of the more expensive bored box, which requires considerable care in fitting. With this metal it is possible to line bearings quickly, and its extensive use is due to the resulting economy, rather than to the anti-friction qualities which it possesses. The temperature at which it becomes molten is low, and, consequently, it is easily melted over a common forge fire. By the use of a babbitting mandrel, the diameter of which is equal to, or slightly greater than, the journal of the bearing, the operation of boring is eliminated. For bearings which are large and important, however, the mandrel is often made smaller than the finished bearing, and the latter is bored after the metal has been expanded and compressed. It is common practice when babbitting two-part bearings, to expand the metal by beating it with the peen of a hammer, but owing to the lack of room, this method cannot be employed when the bearings are solid, especially if small and of considerable length. The same result is obtained in such cases, by forcing a tapered arbor through the bearing in a broaching press, or by other means, the size of the arbor being such as to leave



Plan of a Duplex Bed, showing Method of setting the Babbitting Mandrel when Lining the Pillow-blocks.

* With Shop Operation Sheet Supplement.

sufficient metal for reaming or boring. Still another method which has proved satisfactory in practice, is to bore the bearing to within about 1/32 inch of the finished size, replace the boring tool with a cylindrical piece of steel having polished spherical ends, and feed the latter through the bearing. The length of the tool should be sufficient to compress the hole to within reaming size. As is well known, there are on the market a number of alloys known as babbitt metal, some of which are of inferior quality. If care is taken, however, to obtain a high grade metal, small and medium-sized bearings may be lined with it, and in use will prove satisfactory, without any peening or stretching, as the shrinkage of such metal in cooling is comparatively slight.

Obviously, before the metal is poured into the bearing, the mandrel must be set in correct relation to the other parts of the machine. When there are surfaces which have previously been finished, such, for instance, as the guides for the cross-head, these may be used to advantage in setting the mandrel. If much work of this kind is being done, what are known as babbitting jigs should be made. These are simply fixtures which bear against or fit into any finished surface or hole with which the mandrel must be aligned, and which hold the latter in the correct position while the babbitt is being poured. In the present article, the method of setting the mandrel, and babbitting the pillow-blocks of a small duplex vacuum pump bed, will be presented. This pump is of the type having forked connecting-rods which straddle the steam cylinders. The cross-heads are located between the steam and air cylinders, and are supported entirely by the piston-rods, instead of by guides; therefore the top of the bed and the sides of the pillow-blocks are the only finished surfaces available in this case.

Before the bearings are babbitted, the machine work on the pillow-blocks and caps should be completed, and, as both parts of the bearing, in this case, are to be lined at one time, the caps should be fitted and bolted into place. Steel liners about ⅛ inch thick should be inserted beneath them at points *d*, so that when the bearings have become worn, the play may be taken up by lowering the cap *A*, which is easily done, simply by inserting thinner liners. The anchorages for retaining the metal in the bearings, if they are not cored into the casting, should also be cut or drilled in. The babbitting mandrel is then set in place in the bearing, in the position which is subsequently to be occupied by the shaft. This mandrel is the exact size of the shaft, and the type here shown is provided with a clamping collar *B* which holds it in position, and two adjustable collars *C* and *D* which retain the molten metal.

In setting the mandrel, there are three requirements which must be considered: the center line *c*—*c* of the crank-shaft must be at right angles with the center line *a*—*a* of bed, and parallel with, and, approximately, at least, the required distance above the top surface of the latter. It is desirable that the shaft, when in place, be concentric with the bosses *e*, and, therefore, we shall assume that sufficient metal was removed from the top surface of the bed to make the distance *h* approximately the drawing dimension. This being the case, we have only, when setting the mandrel for height, to adjust it until the collars *C* and *D* are concentric with the bosses. The next step is to set the mandrel parallel with the finished surface of the bed. Locating points for accomplishing this quickly and accurately, may be provided by finishing small spots *f* beneath the bosses at the time the casting is planed; each spot, of course, being machined at the same setting of the tool. The mandrel is then set by calipering from these spots to the flanges of the collars *C* and *D*, which should be of the same diameter. If, however, such spots have not been provided, the same result may be obtained by holding a straight-edge, long enough to reach out to the mandrel, on the surface of the bed, first on one side and then on the other, and calipering the distance between the mandrel and the straight-edge.

If the bed was properly set when planed, the sides of the pillow-blocks will be parallel with the center line *a*—*a*, but as these surfaces are small, they cannot well be used for squaring the mandrel with this line. A line at right angles with the line *a*—*a*, however, can easily be scribed while the bed is on the planer, by placing a pointed tool in the tool-post, lowering it just enough to graze the finished surface of the bed, and feeding it across. The mandrel may then be set parallel with this line by the use of an inside micrometer gage having a bent point, as shown at *E*. This is a convenient and accurate method, but if no such line has been made, a long straight-edge *F* may be set at right angles with the line *a*—*a*, and used instead. To accomplish this, a wooden centering piece is inserted between the pillow-blocks, and a point *G* located midway between their inner surfaces. A point *H* is also located midway between the center lines *b*—*b*, if the central point used in setting the bed on the planer is not visible. Then, with a pair of long trammels, arcs *g* and *h* are scribed from the centers *G* and *H* respectively, and the edge of straight-edge *F* is set to coincide with the intersection of these arcs. The mandrel may then be set parallel with the straight-edge. As the former is above the latter, a gage equipped with a special leg, as shown at *K* in the engraving, will be found convenient for accurately measuring the distance between the two. This leg simply consists of a short cylindrical piece *l* (drilled to receive the gage wire) which bears against the surface of the bed and straight-edge, and insures the same vertical contact against the latter. As will be seen by referring to the engraving, this gage can only be used, in this case, at points *m* and *m*, where the straight-edge is in contact with the bed. If the mandrel is shorter than the one here shown, lines *n* and *o*, equidistant from the edge *F*, can be scribed with a pair of hermaphrodite calipers, and a gage *E* used to set the mandrel from these lines. Of course, after each horizontal adjustment, the mandrel is tested for parallelism from the spots *f* or with a straight-edge, as explained. The middle collar *C* should not be set against the boss *e* and tightened, until after the necessary adjustments have been made.

Prior to pouring the babbitt into the bearings, the latter should be heated somewhat to prevent the molten metal from being chilled when it comes into contact with the casting, as this would make the metal sluggish and doubtless result in an imperfect lining. It is also the practice to smoke, or cover with paper, those parts of the mandrel which are to come into contact with the metal, when babbitting solid bearings, to facilitate the removal of the mandrel from the bearing when the metal is cooled; but for two-part bearings, such as herein illustrated, this will not be necessary. As before stated, both the pillow-blocks proper and their caps are to be lined at one pouring of the metal. To accomplish this, liners *r* of cardboard, a little longer than the length of the bearings, are inserted between the caps and the pillow-blocks to prevent the metal, when it is poured into each of these parts, from uniting; the bed is then turned on its side, so that the mandrel stands in a vertical position, and the metal is poured from the ends of the bearings. When the bearings are being scraped, as described on the Shop Operation Sheet accompanying this issue, the shaft itself, or a special scraping-in mandrel should be used as the hot metal is apt to spring the one used when babbitting. A portable forge, preferably with a coke fire, is desirable for heating the metal, as it can be brought to the place where the work is being done. When the fire is some distance from the work, the metal is often over-heated, to prevent it from being too cool for pouring, and the effect of high temperatures on metals of low fusibility is always harmful. The method of testing the temperature of the metal (given in the Shop Operation Sheet accompanying this issue) by heating it sufficiently to char a pine stick, is perhaps as reliable and practicable as any—at least it has the merit of simplicity, which should prevail as far as possible in connection with all shop work.

* * *

During the month of October the "surprise tests" on the Pennsylvania Railroad, numbered 22,831, and with the exception of 82 cases, the employes obeyed the rules to the letter. Of these tests, 3,365 were for the observance of block signals set in unexpected ways, and the percentage of those observing these signals was 99.1. To ascertain the thoroughness with which employes observe emergency signals, such as fusees, torpedoes, etc., 3,357 trains were tested, and in 99.6 per cent of the cases the rules were obeyed perfectly.

APPLICATION OF LIFTING DEVICES TO ASSEMBLING WORK.

ALFRED SPANGENBERG.*

In assembling work, the operation of scraping the sliding or revolving machine elements to a fit, necessitates their being lifted and turned over a number of times. When the pieces are too heavy to be lifted by hand, the importance of providing efficient lifting devices is much greater than is usually apparent. Very frequently the time consumed by the scraper hands in trying the pieces together to find the bearing, and in waiting for the crane, exceeds, by quite an appreciable percentage, the actual length of time consumed in the operation of scraping.

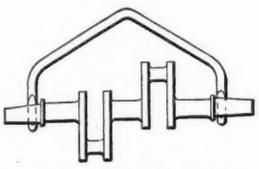


Fig. 1. Machine Steel Sling for Lifting Crank-shafts.

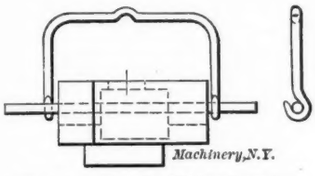


Fig. 2. Device for Lifting Turrets.

In many instances a properly designed lifting device is far superior to a chain or rope for handling the work, and in cases where a device can be designed to eliminate the use of both a chain and crane, a large saving in time can reasonably be expected. The main points to be considered in the design of an efficient lifting device are stated in the following rules:

1. The device must be safe and simple.
2. It must admit of being quickly attached to the piece to be handled.
3. Avoid the necessity of detaching the device when trying the pieces together.
4. In case the work has to be turned over to scrape the surface, balance the piece so that it will swivel easily and yet hang in a position to slide or lower onto the fixed member.
5. Make the device adjustable to allow for the varying center of gravity in similar pieces of work.

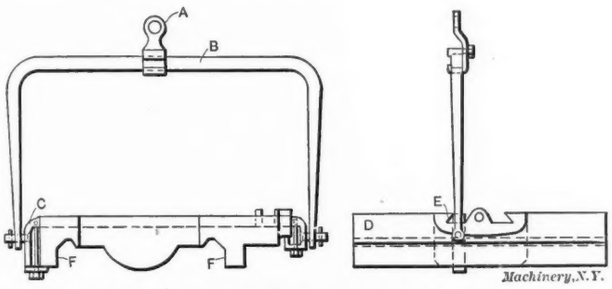


Fig. 3. Sling for Lifting Lathe Carriages, which is equipped with an Adjustable Crane-hook Eye.

6. If possible clamp the device to the work by making use of holes already in the work.
7. Admit of close adjustment for height.
8. Handle the work without the use of a chain or crane.

The accompanying engravings illustrate a number of lifting devices, and suggest their application to a variety of work. The function of the device illustrated in Fig. 1 is clearly indicated by the sketch. The device is made of round machine steel bent to the shape shown. Fig. 2 represents another application of a similar device for lifting turrets. The device is attached to the turret by means of a round bar passing through the holes in the turret. The ends of this bar are left long to serve as handles for revolving the turret on its carriage to find the bearing. A device of this character covers the fundamental principles laid down in rules 1, 2, 3, and 4.

The device shown in Fig. 3 is for handling a lathe carriage, and illustrates an application of rule 5. It will be observed that the eye *A* can be adjusted along the frame *B*. This is to balance the carriage and allow for the varying center of gravity in different carriages. The method of clamping the swivel bar *C* to the carriage is clearly indicated. The carriage is balanced lengthways so that the end *D* will be raised first, the object being to prevent the swivel bar *C* from slipping away from the angle *E* of the carriage. In some designs the sides of the carriage at *F* are a close fit on the lathe bed. In this case the carriage may bind when being lifted off the bed, and if a power crane is used there is danger of springing the carriage. The safety device shown in Fig. 4 overcomes this difficulty, and is so simple that little explanation is needed. The device is suspended from the crane hook by the link *G*. The hook *H* is for attaching the carriage by the device shown in Fig. 3. When lifting the carriage off its bed most of the weight is taken by the crane; the lever *I* is then pulled down until the spring pin enters the hole *J*, when the carriage is clear of the bed. The operation is reversed for lowering. By this method any tendency of the carriage to bind is quickly felt, and the danger above referred to avoided.

Fig. 5 illustrates a method of lifting a swivel by hand. Two round machine steel bars, about 12 inches longer than the swivel, are laid one in each angle and bolted together as indicated. The projecting ends serve as handles to lift

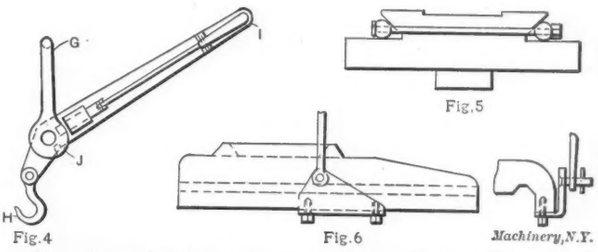


Fig. 4. Crane Attachment, for ascertaining whether a Piece being lifted from its Seat binds. Fig. 5. Device for lifting a Swivel by Hand. Fig. 6. Method of attaching a Lifting Device to a Turret Carriage.

the swivel. In case the swivel is lifted by a crane, a sling chain is passed around the handles to lift the swivel from its shoe; it is easily turned over by making a hitch to one of the bars.

The method of attaching a lifting device to a turret carriage is clearly indicated in Fig. 6. The point mentioned in rule 6 is observed in its design, and the holes already drilled in the turret carriage for the gibs are made use of for clamping the swivel plates.

The gravity tongs shown in Fig. 7 are very efficient for handling work of the character represented. They are so simple that no description is necessary.

For lifting a lathe face-plate for the purpose of screwing it onto the spindle, the method shown in Fig. 8 is very convenient and enables the work to be done quickly. The face-plate is lifted by the gravity tongs. The taper shank of the pin *A* fits into the spindle *B*, and the straight end is an easy fit in the hole of the face-plate. When the pin is lightly driven into the spindle hole, it supports the face-plate after it is released by the tongs. Being thus centered and free to revolve, the face-plate is easily screwed onto the spindle.

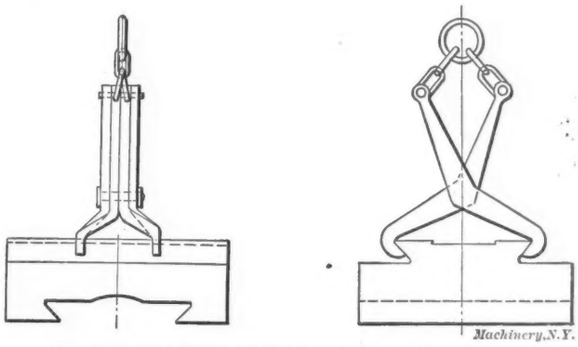


Fig. 7. Gravity Tongs for Handling Work such as illustrated.

Especially where head-stocks are built in lots, this method of screwing on the face-plates will save considerable time.

The function of the device shown in Fig. 9 is clearly indicated by the drawing. The device is an application of rule 7, and is for lifting turret lathe chucks when attaching them to the chuck gear. The T-slot in the chuck is made use of to clamp the device. The turnbuckle, with its right- and left-

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hand threads, provides an easy adjustment for height so as to center the chuck with the gear.

In shops where the crane facilities are limited, the jib crane shown in Fig. 10, which is used in connection with an air hoist or chain fall, will be found very useful. With this outfit there is no excuse for not being "on the job." The ball thrust bearing *A* allows the arm to be swung easily when under load. The base can be clamped to a lathe bed, cross-rail, or any solid foundation, and the device used in connection with the lifting devices previously referred to.

Fig. 11 shows two views of a device designed by the writer, for fitting a saddle onto a boring mill or planer cross-

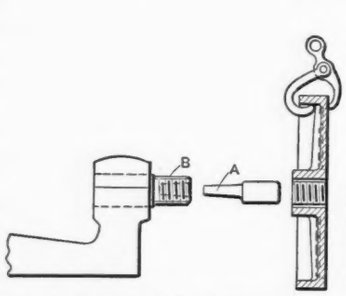


Fig. 8. Appliances which Facilitate placing the Face-plate on the Lathe Spindle.

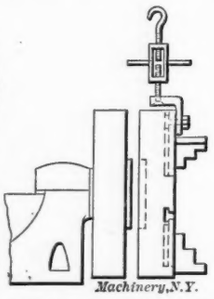


Fig. 9. Crane Attachment for Lifting Turret Lathe Chucks.

rail. Rule 8 is observed. The object of the device is to provide a means for holding the saddle in a position to scrape, turn it over, and slide it onto or off of the cross-rail, without the use of a crane. Referring to the illustration, the frame *A* has four legs *B*, and is fastened to the cross-rail by the braces *C*. This frame serves the purpose of a track to guide and support the saddle *D* when it is off the cross-rail *E*. The saddle is carried by the strap *F* and rollers *G*, and when in position to be scraped, is held by the clamp *H*. By referring to the elevation shown in Fig. 12, of a similar device, it will be observed that the frame at *I* is cam-shaped. The object of this curve in the track is to keep the saddle from touching the end of the cross-rail while being slid on or off, making the operation easy and preventing a false bearing being made on the saddle, as would be the case if the saddle had to drag over the end of the cross-rail. Fig. 12 represents the end of a boring mill cross-rail lying on horses, in position to have the saddle fitted. In practice the edge *J* of the cross-rail would be elevated slightly so as to easily keep the saddle in contact with this edge when it is being slid along.

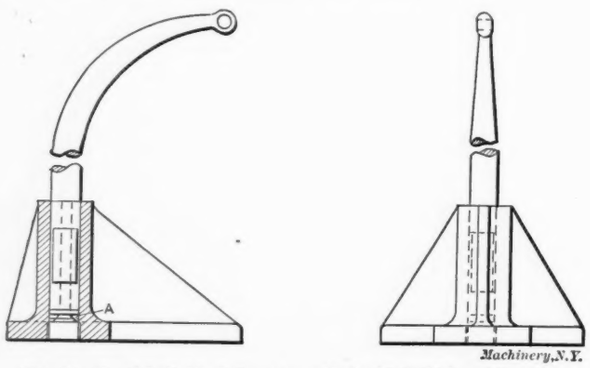


Fig. 10. Small Individual Crane provided with Ball Thrust Bearing.

When using a power crane, and lifter similar to the one shown in Fig. 3, for doing the work just described, trouble was experienced in obtaining the proper adjustment for height so that the saddle would slide easily onto or off of the cross-rail. This was to be expected, as the variation in height had to be within a limit of say ¼ inch, an adjustment not easily obtained with a power crane. The main advantage to be gained, however, by using the device illustrated in Fig. 11 was in not having to wait for the crane. A similar device could easily be made for handling lathe carraiges when fitting them to the bed.

* * *

The United States exported $267,524 worth of aluminum in eight months during 1908.

CARNEGIE'S PROFIT-SHARING PLAN.

An equitable reward for labor—that is, a just share in the profits as well as the losses of an enterprise—may be impossible under present economic conditions, but there are many able thinkers who believe that it can be more nearly realized than is possible with any of the existing schemes of stimulating production, *i. e.*, piece-work, bonus, premium, "individualized efficiency," etc. The result of all the existing plans has been, sooner or later, to *fine* the worker for greater production by reducing wages. The consequence is that workmen have virtually set a limit of daily production in almost every industry beyond which they will not go.

Andrew Carnegie, in his new book, "Problems of To-day," makes the prediction that the wage system as it is at present maintained is doomed to extinction. He sees ahead to the time when the wage worker of to-day will be the partner in a profit-sharing system which will do away with all the recognized methods of rewarding labor. Mr. Carnegie's idea is that the profit-sharing system will extend so far that all branches of industry will adopt it. He advocates the guaranteeing to the workingman of the minimum wage, solely to keep his mind easy and free for his work, but the wage should only be a part of the pay of the worker. He should have an inter-

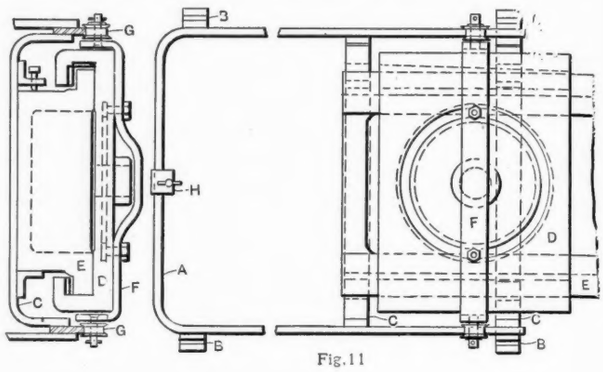


Fig. 11

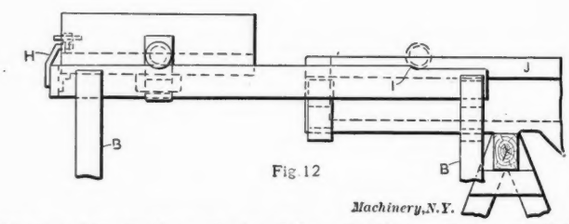


Fig. 12

Machinery,N.Y.

Figs. 11 and 12. Device used when fitting a Saddle to a Cross-rail, which enables the Former to be removed from the Latter and scraped, without the Use of a Crane.

est in the business—a partner's interest—with the status of a share-owning official and a voice in the management. The workingman and the capitalist, under the universal profit-sharing system, will become one. He holds that the universal profit division system will not only benefit the workingman, but will be a great help to business and industry generally. With every employe a shareholder in the particular shop or establishment that claims his labor, most of the disputes between capital and labor would be prevented. There would be a feeling of mutual regard, which is now sadly lacking.

"Thus we see that the world moves on, step by step, toward better conditions. Just as the mechanical world has changed and improved, so the world of labor has advanced from the slavery of the laborer to the day of his absolute independence, and now to this day, when he begins to take his proper place as the capital-partner of his employer. We may look forward with hope to the day when it shall be the rule for the workman to be partner with capital, the man of affairs giving his business experience, the workingman in the mill his mechanical skill, to the company, both owners of the shares, and so far equally interested in the success of their joint efforts, each indispensable, so that without their cooperation success would be impossible. I am convinced that the huge combination, and even the moderate corporation, has no chance in competition with the partnership which embraces the principal officials and has adopted the system of payment by bonus or reward throughout its work. The latter may be relied upon, as a rule, to earn handsome dividends in times of depression, during which the former, conducted upon the old plan, will incur actual loss, and perhaps land in financial embarrassment."

LETTERS UPON PRACTICAL SUBJECTS.

Articles contributed to MACHINERY with the expectation of payment must be submitted exclusively.

ACCURATE METHOD OF SETTING MILLING CUTTERS.

In a certain shop where gears are required to be cut within a limit of 0.00025 inch, the cutters are set in the following manner:

1. The cutter is centered over the arbor as nearly as possible, with a gage.
2. The blank is clamped to the arbor and a cut is taken through.
3. The blank is taken off the arbor and the cut is colored with copper sulphate.
4. The blank is *reversed* on the arbor and *not fastened.*
5. The cutter is run through the cut again and the points where the cutter touches noted.
6. The table is re-adjusted and the operations repeated until the cutter touches evenly on both sides.

The blank floats on the arbor when reversed and not clamped, and if the cut is not exactly central, the cutter will rub off the copper on one side of the cut at the bottom and on the other side at the top. H. G. H.

CHANGING OLD LATHE TO INCREASE CUTTING VALUE.

We were blessed with a supply of old lathes that had small cutting power and light feed, and while they were probably good for certain work, they were not suitable for all our work, particularly for shaft turning, as frequently we had more than

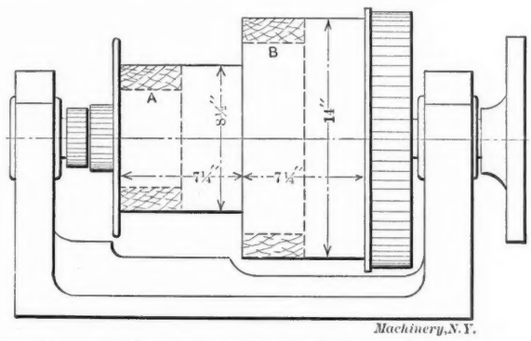


Fig. 1. Change in Cone Pulley to Provide for Wider Belt.

the customary amount to turn off on the ends; consequently it was decided to try to change one of our most promising looking lathes into one with some modern qualities. We wanted to make it as powerful as was possible under the existing circumstances, and this was accomplished as explained in the following:

The lathe chosen for this change had the customary four-step cone pulley, driven by a 3-inch single belt, and the ordinary carriage feed. In order to get more pulling power, the width of the belt had to be increased, which was done by changing the cone pulley from a four-step to a two-step cone. This change was accomplished by rough turning the steps at *A* and *B*, Fig. 1, and forcing a solid wooden ring on at *B* and putting one on in halves at *A*. In order to get good holding power of the wood on the iron, three coats of shellac were applied, each one being allowed to dry before applying the other. The last coat was allowed to dry until it was in a sticky condition, then the wood was pressed on the pulley and further secured from turning by screws. The wood and iron surfaces were then thoroughly covered with thick paper. The counter-shaft cone pulley was changed in the same manner. This allowed us to get a 6-inch double belt on the cone pulley. A corresponding increase of power was made in the drive from the line to the counter-shaft. Fig. 1 shows the arrangement of the cone pulley after the change had been made, the dotted lines showing the original contour.

The tool-post had to be made stronger (for the present one would not take the cut that the 6-inch belt could pull) and Fig. 2 shows how this was easily and cheaply accomplished. All parts, except the screws, are cast iron, and did not cost very much to make. The holder has two tool-slots which allow a wide range for the tool without the necessity of changing the position of the post. The tool-post can be raised or lowered easily by the ¾-inch adjusting screw *A*, and the slot cut in the lower flange allows the post to be clamped

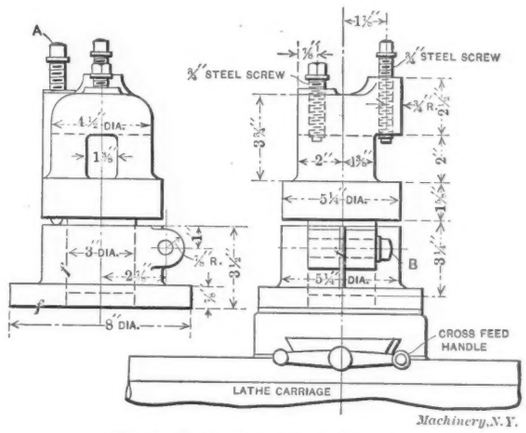


Fig. 2. The New Design of Tool-post.

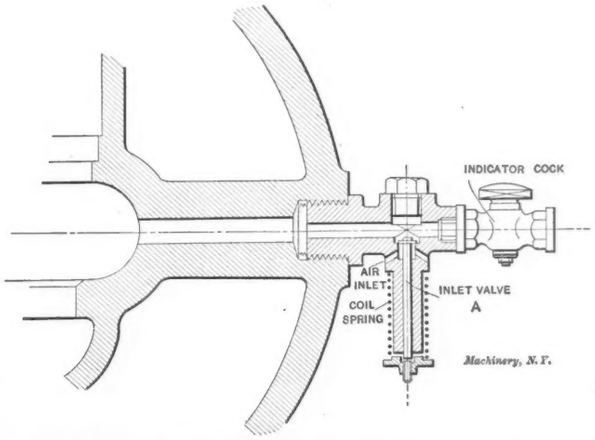
by the set-screw *B* and securely held in any position desired by the operator.

The change was made for a comparatively small cost, and it increased the cutting value over 100 per cent, and paid for itself in a short time. O. JAMES.

Providence, R. I.

AIR INLET VALVE FOR INDICATOR PIPES OF INTERNAL COMBUSTION ENGINES.

The difficulties met with in taking indicator diagrams of internal combustion engines operating on low grade gases, due to ignition taking place during compression, have often been discussed in the technical papers. The journal *Haeders Zeitschrift* which is devoted to accidents, lately cited several cases where it was impossible to take diagrams because the pipe or passage which leads to the indicator, acted in the same way as an ignition tube. So far as the motors themselves are concerned, it is necessary to stop up this passage in order to permit the machine to operate normally.



Gas Engine Indicator Pipe with Air Inlet which prevents it from becoming Heated.

These inconveniences we have likewise experienced, but we have completely overcome them, thanks to our valve for admitting air, which is illustrated in the diagram shown herewith. During the suction of the mixture, valve *A* permits the outside air to enter and clear the indicator passage of all burned gases. As the tubes are full of pure air during the compression stroke, the mixture is prevented from entering, and, furthermore, the air cools the passage to the indicator

very effectually. This valve can be employed with very good effect also for cooling any closed cylinder space which heats too rapidly, or a corner where the hot gases have a chance to remain confined and thus produce premature ignition. The device can also serve to cool the valves without water, introducing the air through the stem.

Société Anonyme des Moteurs a Gaz A Bollinckx.
Huyssinghen, Belgium.

WINDING SPRINGS WITH INITIAL TENSION.

There are many spring winding devices, but it is seldom one sees anything for winding springs with initial tension, and, in fact, many mechanics would be "up against it" if given a job of this kind. One of the simplest and most effective de-

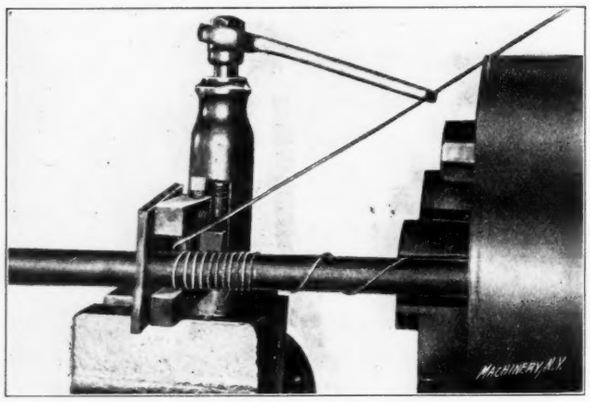


Fig. 1. Method of Winding Spring with Lathe running Forward.

vices that I have seen for this work, was made by W. A. Bright, foreman of the Decatur Novelty Works.

For the sake of clearness, and to show the way the wire runs when winding, I have used a piece of coarse string and have wound it on the mandrel with the coils apart to show the direction of the spiral. Fig. 1 shows how a spring is wound with the lathe running forward, the wire being fed from the operator's left as he stands in front of the lathe. Note the way the cord is run half around the guide pin, and how it is shoved over against the last coil by the pin as it comes around the mandrel on the first turn. Fig. 2 shows the way wire is fed from the back, which Mr. Bright considers the handiest. When winding in this way the lathe is reversed, and the wire is given about a three-quarter turn around the guide pin as it feeds on the mandrel. In winding a spring in this way, the lathe carriage must be fed

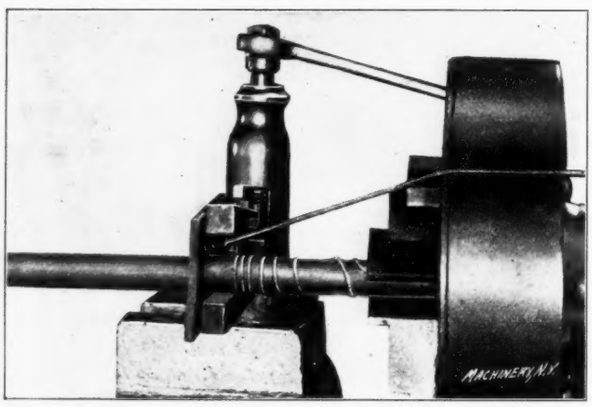


Fig. 2. Winding Spring with Lathe running Backward. Note that Wire makes Return Bend around Guide Pin.

along so as to give it a lead of a few thousandths inch over the winding of the wire, in order to prevent the wire from climbing upon the coil.

Two of the springs wound in this way are shown at *A* and *B*, Fig. 3, and the amount of initial tension is shown by the spring at *C*. This spring is of 14 gage wire, ⅜ inch in diamter, and 3 inches long. The scale registers 24 pounds and the coils have separated so little that it is impossible to insert a common business card. The large spring *E* registered 50 pounds on another scale, with no sign of separation. The device shown at *D* is the same as shown in the lathe in Figs. 1 and 2. The spring *E* is inserted in an exceedingly handy jig for forming the loop on the end. The construction of this jig is too clearly shown to need explanation.

Decatur, Ill. ETHAN VIALL.

ECONOMICAL DESIGN.

The work of the draftsman, though primarily concerned with the correct layout of mechanisms for performing certain predetermined operations, does not end, by any means, when this layout has been brought within the limits of machine construction, or rather within the realm of mechanical feasibility. When the arrangement has reached this stage, it is absolutely necessary that every detail of the mechanism be carefully considered with reference to its manufacture. Slight modifications in the design of the details often make a big difference in the cost of manufacture, and modern conditions demand that this phase of machine design be very carefully considered.

The engraving shows a sectional plan of a lathe apron, designed by the writer, which will perhaps more fully illustrate what is meant by the title of this article. *A* is a straight-face worm gear driven by the worm on the splined lead-screw. *B* is a friction gear which, by means of a tumbler gear (not shown), may be connected at will either to the gear *C* or the cross-feed-screw pinion (not shown). The gear *C* is keyed to the mild steel rack pinion *D*. *E* is the hand feed-shaft pinion; *M*, the apron; *H*, the apron cover bolted to the front of the apron; *F*, the lead-screw half-nut; *L* the cam for engaging the lead-screw nut, and *G*, the lever for operat-

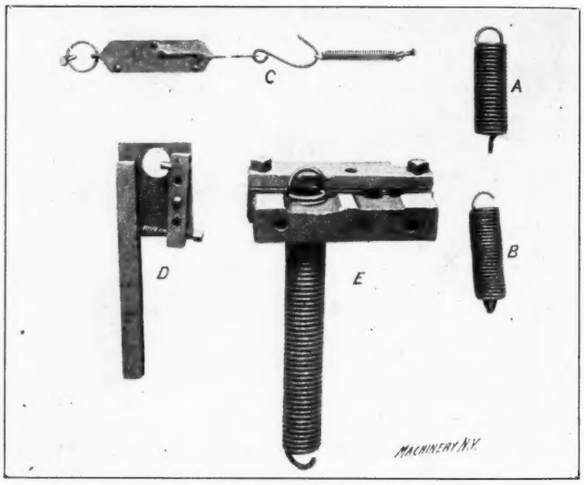


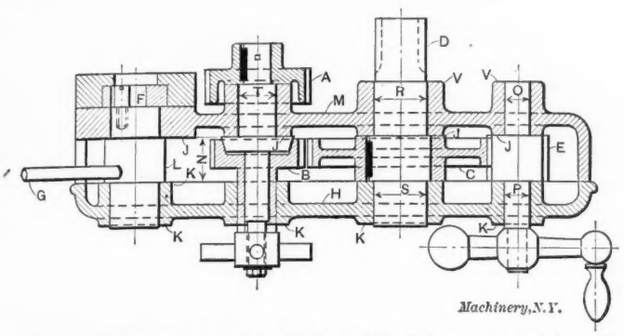
Fig. 3. Sample Springs and Device for Guiding the Wire as it is wound on the Mandrel.

ing the cam. All the bosses *K*, on the apron cover, are the same height so that they may be machined on the planer in quantities. A measuring block is used to set the tool to the proper height. One setting of the tool sizes the whole lot, whereas, if these bosses were faced on the drill press, there would have to be twelve measurements made (including those for the two shafts not shown) to insure an accurate job. Similarly, all the faces *J* on the inner side of the apron *M* are in the same plane. These faces also are machined on the planer and the dimension *N*, that is, the distance from the face *J* to the apron cover seat, obtained from a suitable measuring block.

It will be seen that practically all facing on the drill press is done away with; in fact, there is only one boss on the whole carriage that is faced on this machine and that is the one for the worm gear *A*. With the exception of the faces *V*, which are not machined at all, all faces are machined on the planer.

Another operation which is perhaps even more important, is the drilling of the holes for the various shafts. There are twelve bearings in the carriage, altogether—six in the apron and six in the cover, that is, six shafts each with two bearings. Before any of the bearings are drilled, the cover is bolted to the apron, after which the whole carriage (the apron and carrriage are cast together) is mounted in a jig

on the drill press. The special feature which I want to point out is that both bearings of each of the six shafts are equal in diameter; thus *O* is the same size as *P*, *R* the same as *S*, and so on. This is of great importance when drilling the bearings, as the drill may be fed straight through both apron and cover in every case. This is a great convenience and saves considerable changing of drills and jig bushings, which would be inevitable if the two bearings of each shaft were



Example of Design in which the Method of Manufacture was considered.

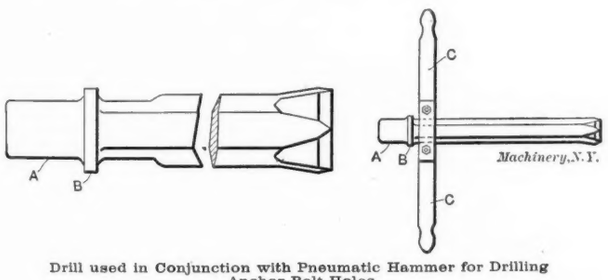
not equal in diameter. Another advantage is that ordinary reamers may be used to ream the bearings, where otherwise special double ones would be necessary to insure correct alignment of each pair of bearings.

There is still another advantage with this design in that none of the shafts, with the exception of *T*, require fastening endways, the apron cover attending to this. Suppose that the pinion *E* were made separate from its shaft and keyed on; if the shaft were put in from the front, the bearing *P* would require to be larger than *O* to allow the key to be passed through, and if the friction of the keyed joint was not depended on, a collar or some other fastening would be required to hold the shaft endways. With the arrangement shown, however, each of the shafts is largest in diameter between the two bearings, so that the shoulders thus formed do away with all end movement. Of course, this is an incidental feature of the design, but, nevertheless, it is a useful one.

Keighley, Yorkshire, England. ALBERT CLEGG.

INTERESTING USES OF THE PNEUMATIC RIVETING HAMMER.

The writer had occasion to set a bed-plate on an old concrete foundation and the thought of drilling eight 2½-inch anchor bolt holes about 3 feet deep, by the old-fashioned method of sledge-hammer and stone drill, set his mind to



Drill used in Conjunction with Pneumatic Hammer for Drilling Anchor Bolt Holes.

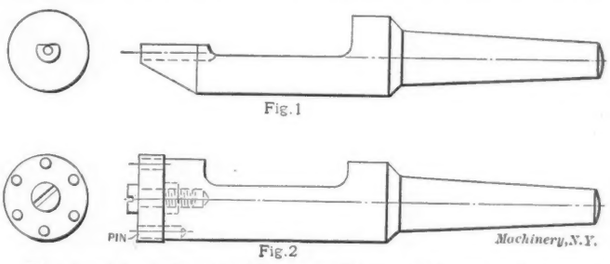
work. The outcome was the making of a stone drill such as shown in the accompanying engraving. The shank *A* was turned to suit a pneumatic riveting hammer, and hardened. Two handles *C* were also provided and bolted under the collar *B*, as shown. It required two men to operate the drill, one to run the hammer while the other turned the drill back and forth about a quarter of a turn. The result was that the holes were drilled in less than three hours, which is only a fraction of the time usually required for the same work by the old method.

Another interesting use of the pneumatic riveting hammer, is to drive out fitted bolts that have become tight by rust or other causes. The instance in this line to which the writer refers was the removal of connecting-rod strap bolts on a small locomotive. These bolts were driven in from the top, and when it was necessary to take them out it was impossible to move them, and as a fair blow could not be given with a sledge, this method was abandoned. A 10-ton hydraulic jack was then tried, and while it would lift one side of the engine, the bolts would not stir. The pneumatic hammer with the ordinary button-set in it was next applied, and the result was that the bolts were removed in less than a minute each.

R. S. F.

IMPROVEMENT IN FEMALE CENTERS FOR FLUTING SMALL TAPS.

The improvement in female centers shown in the accompanying illustration is intended to be used when fluting taps 3/16 inch in diameter or smaller, provided with male centers. In Fig. 1 is shown the ordinary half center, as usually employed, which is expensive to make, and which is not very satisfactory, as it does not hold the tap as securely as a solid center. Besides, these centers wear out quickly, and the cost of maintenance therefore becomes considerable. In Fig. 2 is shown an improvement which possesses several advantages. The centers themselves are located in a circular washer or disk, having a projection on one side, which fits into a recess in a shank, which in turn fits into the tail-stock. These round disks are made from tool steel but are not hardened, while the shank is made from machine steel. The object of not hardening the disks is to avoid the risk of



Figs. 1 and 2. Ordinary and Improved Forms of Centers for Holding Small Taps when fluting them.

breaking the fluting cutter if it should happen to run into the disk when fluting very small taps. The disks are provided with six holes, and as soon as one wears out, the disk is simply turned around to the next hole until all six are worn out. The disks are held to the holder by an ordinary fillister-head screw. In order to bring the hole used as a center in line with the spindle, the bottom hole is provided with a small pin which fits into a corresponding hole in the holder. One of these center disks will last five times as long as the center shown in Fig. 1, and as it costs no more to make, the advantage gained is obvious. CHARLES E. SMART.

Greenfield, Mass.

INDEXING IN DEGREES AND MINUTES.

Here is a kink that may be of interest to some brother tool-makers or machinists. Some time ago I had a job that required to be indexed in degrees and minutes, and this is the way it was done: Taking a B. & S. indexing head, I used the 54-hole division on the plate, which gave me 1 degree every 6 holes, or 10 minutes to one hole. I then made a plate, as shown in the engraving, where *A* is a stud that fits any of the 54 holes and serves as a pivot for the plate. The 9 holes are located so as to divide the space between two holes, of the 54-hole circle, into 10 equal parts, each part being equivalent to 1 minute on the work. With this arrangement, I was able to index any number of minutes.

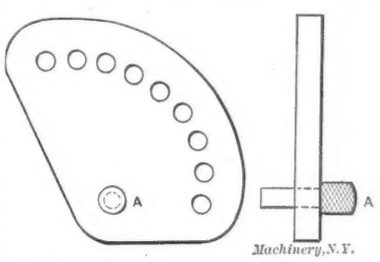


Plate for Dividing the Space between Two Holes on the Index Plate so as to obtain Minute Divisions.

New Britain, Conn. J. MATHIEU.

[An index plate having a 54-hole circle is special on Brown & Sharpe machines, but a regular 27-hole circle could also be

used for indexing to minutes. Obviously, the number of holes for indexing one degree would be one-half that of the former case or 3 degrees; therefore it would be necessary to double the number of holes in the dividing plate to obtain one-minute divisions.—EDITOR.]

UNIQUE METHOD OF FINISHING CYLINDERS.

The cylinder and piston shown in Fig. 2 are used on a gas machine for automatic block signals. They are made of bell metal, and the piston was required to so fit the bore of the cylinder that sufficient gas, under 40 pounds pressure, would leak past it to bring the pressure in a receiver of given size, up to 30 pounds, in 10 minutes. This job was a very expensive one, as a variation of a thousandth of an inch one way or the other would mean that the requirements would not be fulfilled. Originally these cylinders were bored and then lapped to size with vaseline and powdered glass. By this method about three out of every ten stood the test. I was given this job to perfect, and as it was the first work that I had done in this particular shop, I felt somewhat uneasy, but went ahead with it nevertheless. Twenty-five cylinders were first bored on the lathe with a boring-bar, to within from five to ten thousandths of an inch of the finish size, which is 2½ inches. The cylinders were then pressed on mandrels and turned on the outside. While doing this I thought of a scheme for finishing the bore which would not only make it possible to do the work quickly and accurately, but which would produce a smooth surface as well. The plan was to enlarge the cylinders to the finish size by forcing hardened tool steel plugs through them, each plug being slightly larger than its predecessor. Four tool steel plungers, 12 inches in length and varying in size from 2.441 to 2.500 inch, were turned, hardened, and ground and the ends rounded to prevent the cylinders from being roughed. A press, as shown in Fig. 1, was then made for forcing the plungers through the cylinders. Its construction is so simple that little explanation is necessary. The cylinder *A* was clamped between two plates *B* having annular recesses into which the cylinder flanges fit. The four steel plungers *C*, beginning with the smallest, were then forced through the cylinder by a 10-ton hydraulic jack. The bores of the cylinders, when finished by this method, were as smooth as a gun barrel and the required size.

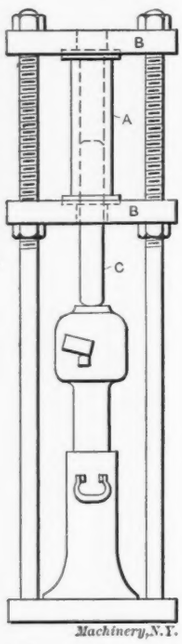


Fig. 1. The Press equipped with a 10-ton Hydraulic Jack.

The next thing was to determine how much to grind the pistons under size to give the amount of leakage required.

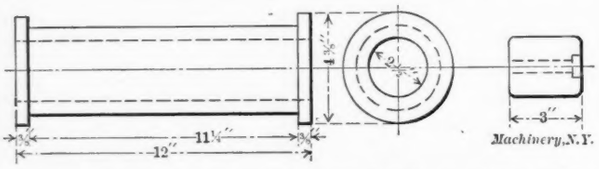


Fig. 2. The Cylinder, the Bore of which was finished by forcing Hardened Steel Plugs through, as illustrated in Fig. 1.

By experimenting, this was found to be three-fourths of a thousandth. All of the pistons were then ground to the same size by the aid of a micrometer. This method of doing the work was so successful that twenty-four out of twenty-five of the pistons and cylinders stood the test. Before testing, part of the hole through the piston, which was drilled in for the arbor, was plugged with babbitt. The piston was then placed in the cylinder and the ends of the latter tightly closed. The gas, under 40 pounds pressure, was then admitted to one side of the piston and the time noted. If, after a lapse of 10 minutes, the gage connected to the opposite side of the piston by a short length of pipe, indicated 30 pounds, the relative sizes of piston and cylinder were correct.

Plainfield, N. J. JOSEPH R. WEANER.

POWER TAPPING.

In ordinary shop practice hand tapping has been most commonly used, but in recent years, with the improved tapping machines, tapping attachments, and collapsible taps, power tapping has in many instances taken the place of the hand tapping method. Of course, in some cases it is impossible to do anything else but tap a hole by hand.

The great disadvantage of tapping by hand is the time consumed. While cutting a thread with a tap is not a difficult job, it requires care in the manipulation. To tap a hole by hand requires two or three taps. The first tap is the taper tap. This starts the thread and care must be taken when starting this tap to keep it parallel with the hole to be tapped. Then the plug tap is used which completes the thread. If the threads go to the very bottom of a "blind" hole, the third tap is used, which is called the bottoming tap.

SPEED OF STANDARD TAPS.

Diameter of Tap.	Cast Iron.	Wrought Iron.	Diameter of Tap.	Cast Iron.	Wrought Iron.
3/16	340	265	1	72	57
1/4	295	230	1 1/8	63	50
5/16	240	190	1 1/4	57	45
3/8	197	152	1 3/8	51	41
7/16	170	122	1 1/2	46	38
1/2	145	114	2	34	28
9/16	117	91	2 1/4	30	26
5/8	96	76	2 1/2	26	23
3/4	84	65	..	..	..

When tapping by power one tap is all that is necessary. The tap is securely held in a chuck which guides it straight. In machine tapping it is found advisable to drive the tap by means of a friction tap holder or some other friction drive. The friction must be adjustable, so that enough tension can be secured to drive the size tap being used. If the tap should strike bottom or a hard spot in the casting it will slip.

To secure good results in machine tapping it is necessary to run the tap at the proper speed. Of course, speed depends a great deal on the metal being tapped and the condition of the tap. Under ordinary conditions, with the tap in good shape, speeds of 15 to 20 feet per minute have been found satisfactory. The following table gives the proper range of speeds for taps most commonly used.

Cincinnati, Ohio. A. C. PLETZ.

CRITICAL SPEED CALCULATION.

If the deflection of a revolving part is due only to the weight, the critical speed is always a function of the square root of the shaft deflection. Below are given formulas for calculating the critical speed for four different cases. In the formulas:

W_1 = weight of wheel in pounds,
W_2 = weight of shaft in pounds,
D = diameter of shaft in inches,
l = one-half the distance between bearings in inches,
$L = 2l$,
N = critical speed in R.P.M.

Case 1.—*Unloaded Shaft.*

$$N = c\frac{D^3}{\sqrt{W_2 l^3}}$$

Kind of Bearings.	Value of c.
Two flexible bearings	794,000
Two fixed bearings	1,775,000
One flexible, one fixed bearing	1,285,000

Case 2.—*Single load at center between bearings.*

$$N = c\frac{D^3}{\sqrt{W_1 l^3}}$$

Kind of Bearings.	Value of c.
Two flexible bearings	558,000
Two fixed bearings	1,116,000
One flexible, one fixed bearing	837,000

Case 3.—*Single load; load not at center.*

$$N = c\frac{D^3}{\sqrt{KW_1L^3}}$$

in which formula

$$K = \frac{a(L-a)\ (2L-a)\ \sqrt{2La-a^2}}{L^4},$$

if a = distance from load center to center line of farther bearing.

Kind of Bearings.	Value of c.
Two flexible bearings	900,000
Two fixed bearings	1,800,000
One flexible, one fixed bearing	1,350,000

Case 4.—*Multiple Loaded Shaft.*

$$N = \frac{N_1\ N_2\ N_3}{\sqrt{N_2^2\ N_3^2 + N_3^2\ N_1^2 + N_1^2\ N_2^2}}$$

in which formula

N = critical speed of system,

N_1 = critical speed of unloaded shaft,

N_2, N_3 = critical speed of each load separate.

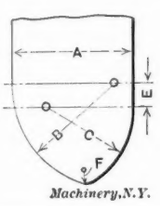
These formulas apply to steel shafts having a modulus of elasticity $E = 30{,}000{,}000$.

E. A. LÖF.

Chicago, Ill.

STANDARD DRILL AND REAMER TABLES.

The accompanying tables give all the necessary data for laying out correct drill and reamer fluting cutters. The drill table stops at the 1¼-inch size. Larger drill cutters are laid



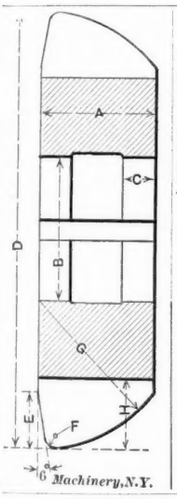
DIMENSIONS OF DRILL FLUTING CUTTERS.

Diameter of drill = D.

Size of Drills, D	A	B	C	E	F
up to $\frac{23}{64}$	0.75D	0.700D	0.540D	0.18D	0.07D
$\frac{3}{8}$ – $\frac{7}{8}$	0.75D	0.630D	0.540D	0.14D	0.07D
$\frac{57}{64}$–1 $\frac{1}{4}$	0.75D	0.625D	0.312D	0.10D	0.07D

DIMENSIONS OF REAMER FLUTING CUTTERS.

(Brown & Sharpe Standard.)



Number of Cutter.	D	A	B	C	E	F	G	H	Number of Teeth in Cutter.	Diameter of Reamer.	Number of Teeth in Reamer.
1	1 $\frac{3}{4}$	$\frac{3}{16}$	$\frac{7}{8}$	..	0.125	0.016	$\frac{7}{32}$	0.21	14	$\frac{1}{8}$ – $\frac{3}{16}$	6
2	1 $\frac{3}{4}$	$\frac{1}{4}$	$\frac{7}{8}$	..	0.152	0.022	$\frac{9}{32}$	0.25	13	$\frac{1}{4}$ – $\frac{5}{16}$	6
3	1 $\frac{7}{8}$	$\frac{3}{8}$	$\frac{7}{8}$	$\frac{1}{8}$	0.178	0.029	$\frac{1}{2}$	0.28	12	$\frac{3}{8}$ – $\frac{7}{16}$	6
4	2	$\frac{7}{16}$	$\frac{7}{8}$	$\frac{1}{8}$	0.205	0.036	$\frac{9}{16}$	0.30	12	$\frac{1}{2}$ – $\frac{11}{16}$	6–8
5	2 $\frac{1}{8}$	$\frac{1}{2}$	$\frac{7}{8}$	$\frac{5}{32}$	0.232	0.042	$\frac{11}{16}$	0.32	12	$\frac{3}{4}$ –1	8
6	2 $\frac{1}{4}$	$\frac{9}{16}$	$\frac{7}{8}$	$\frac{5}{32}$	0.258	0.049	$\frac{3}{4}$	0.38	11	1 $\frac{1}{16}$–1 $\frac{1}{2}$	10
7	2 $\frac{3}{8}$	$\frac{5}{8}$	$\frac{7}{8}$	$\frac{3}{16}$	0.285	0.056	$\frac{27}{32}$	0.40	11	1 $\frac{9}{16}$–2 $\frac{1}{8}$	12
8	2 $\frac{5}{8}$	$\frac{11}{16}$	$\frac{7}{8}$	$\frac{3}{16}$	0.312	0.062	$\frac{7}{8}$	0.44	10	2 $\frac{1}{4}$ –3	14

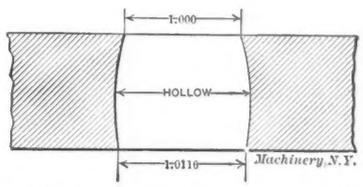
out in the same ratio, approximately; E loses about 0.04 inch for every half inch in diameter that the drill increases until the dimension disappears; C also decreases as shown until it equals one-half of B. In making the formed tool, the outline of the cutter is laid out on zinc and a fly tool made, after which the formed tool is planed and finished.

NOSMOT.

ECONOMICAL METHOD OF MAKING BLANKING DIES.

Die-makers are familiar with the fact that dies when hardened will swell in such a manner that the central portion of the metal in a hole will bulge out towards the center. In order to give sufficient clearance to a die in spite of this tendency, it is necessary to provide for a rather large clearance angle. This being done, it is evident that when the die has been ground down to a certain depth, the hole is very much larger than it was originally, and for many purposes the die must be discarded before it has been used up. The following method of making dies permits them to be ground down until but a small thickness of the steel is left, and as the writer has used the method successfully for the past four years, it may be of interest to others.

Take a die blank one inch thick and lay out the correct form on the blank, drill to the scribed lines, remove the core, and then finish the die with a clearance of about one-third of one degree, or twenty minutes, which will give a clearance of about 0.0058 inch on each side at the bottom of the die. Now, scrape or file the center of the die hollow, as shown in the illustration. The amount removed at the center should be about 0.003 inch. Then harden as follows: Place a piece of cast iron or machine steel larger than the surface of the die on the top of a coke fire, and heat it to a cherry red. Then place the die with the face down on this cast iron or machine steel piece and heat until it is cherry red; then plunge the die in slightly warmed clear water, and keep it in the water until it becomes of the same temperature. Then remove it from the water and quickly place it on the fire again, and heat it until it is warm enough to melt soft string solder. Then dip it again, thereby finishing the hardening and tempering process. When the die is so hardened it will swell about 0.003 or 0.004 inch in the center so that the opening will not be any larger in the center than it is at the bottom, and the die may be ground and sharpened all the way down and used until too thin for service. Dies made in this manner will give better satisfaction and perform about three times as much work, or, in other words, last three times as long, as dies made with the ordinary 1 or 1½ degree clearance. The same hardening process should be followed in hardening punches.



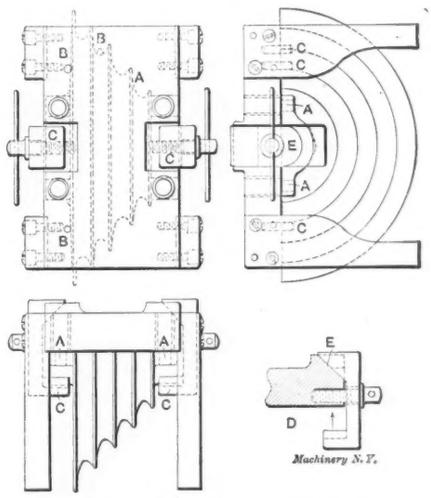
Method of making Blanking Dies which permits them to be ground off on the Face, thus insuring Long Life.

St. Louis, Mo.

JAMES S. GLEW.

JIG CLAMPING DEVICE.

We had a number of cast-iron pulleys that were to be used in connection with special lacing machines, and these were cast in halves to make it convenient to fasten them on shafts that were located beneath the benches, in the factories where the machines were to be used.



Plan and Elevations of Jig with Work in Place.

A jig was made for drilling the four holes A. There is nothing remarkable about its general design, yet it possesses a neat clamping feature which is so superior to the usual method employed, that I considered it worthy of note. To set the casting preparatory to drilling it is placed against

the locating pins *B*, one of them engaging a groove in the casting which sets it in the proper relation with the holes in the jig. The clamps *C* are then tightened, the right side of the casting being clamped first to prevent it from shifting.

The working principle of the clamp is clearly shown in the detail *D*. As the clamp is drawn in it ascends the incline *E*, thus moving in the direction of the arrow and tightening against the hub of the casting. The clamps are made with a V which insures a firm hold. PEDRO.

HOLDER FOR DRAWINGS IN MACHINE SHOP INSTRUCTION.

The accompanying half-tone, Fig. 1, and the reproduction of an instruction sheet, Fig. 2, show a method which has proved successful in the instruction in machine tool work

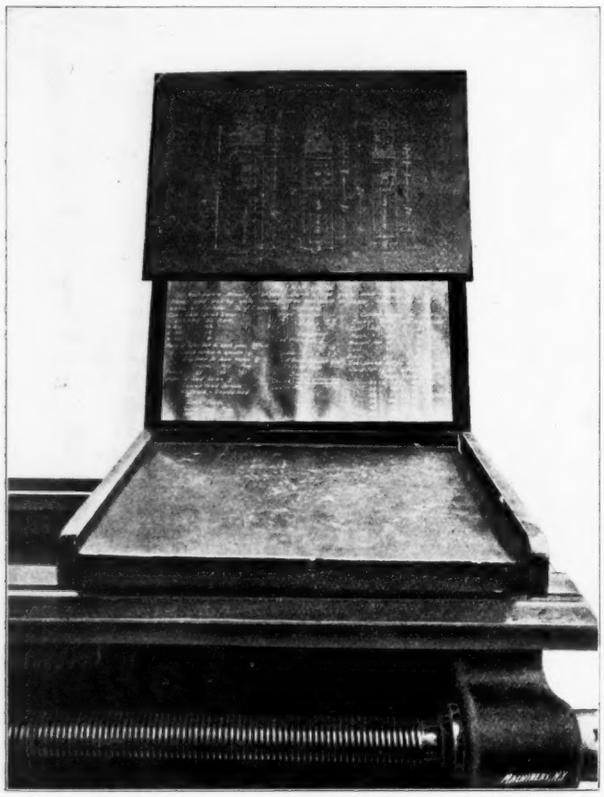


Fig. 1. Holder for Drawings and Instruction Sheets Mounted on End of Lathe Bed.

at the Saginaw High-school, Saginaw, Michigan. The instruction sheet in Fig. 2 gives all the most needed information regarding the machine on which the pupil is put at

Pull belt before throwing in shipper. Do not change gears while running. Never wipe gearing while running. See that mark on center corresponds with same on spindle. Test centers for alignment. Pull gear plug when using split-nut.

Open Belt.	Back Gear.
1. 540 R.P.M.	65 R.P.M.
2. 305 . . .	37 . . .
3. 183 . . .	22 . . .
4. 122 . . .	15 . . .

Ratio of open belt to back gear $\frac{1}{8}$.
Ratio of lead screw to spindle 1.
Ratio of long. feed to lead screw —.

Coarse.	Med.	Fine.
Feeds 0.013	0.009	0.006

Pitch of lead screw $\frac{1}{4}$"
Geared feed set lathe for 6 thread.

Coarse	Med.	Fine.
0.013	0.010	0.007

Speed Formula.

$$\frac{5' \times 12''}{\pi \times D''} \times \frac{4}{1} = R.P.M. = \frac{45}{D}$$

Equipment.
End wrench $1\frac{5}{8}$"
Tool post wrench $\frac{1}{2}$" *sq.*
T-Socket wrench $\frac{5}{16}$" *sq.*
1, 6" *Face Plate.*
1, 12" *Face Plate*
Center Rest.
Chucks.

Cutting Speeds for Metals.

Carbon Tools.	Air Hardened.
Cast Steel 10'	20'
Mach. Steel 20'	40'
Wrought Iron 30'	60'
Cast Iron 40'	80'
Brass 100'	160'

True speed will be what tool will stand for $1\frac{1}{2}$ *hrs. without grinding.*

Change Gears.

25 Th.	45 Th.	65 Th.	90 Th.
30	50	69	100
35	55	70	110
40	60	80	120

Pitch 14

Fig. 2. Sample Instruction Sheet for Machine Shop Classes.

work, and is mounted directly on the end of the lathe bed, as shown in the half-tone. This arrangement has proved a very great convenience, and a most effective means of keeping the needed information constantly before the student. Of course, the cutting speeds are only approximate, and are solely given as a basis of calculation. They are given in such a series as can be most easily remembered by the student. The drawing from which the student is to work is also mounted in the same way, above the instruction sheet, as indicated. The lower part of the board may be used as a desk where the student can carry out simple figuring relating to his work, and make notes and sketches if necessary. It might be added that this idea may be suggestive even for the ordinary machine shops. L. N. BRYANT.

Saginaw, Mich.

ADJUSTABLE EXTENSION TOOL-HOLDER FOR PLANER AND SHAPER.

The accompanying line engraving, Fig. 1, and half-tone, Fig. 2, show the construction and use of an adjustable extension tool-holder which was made to meet the requirements of

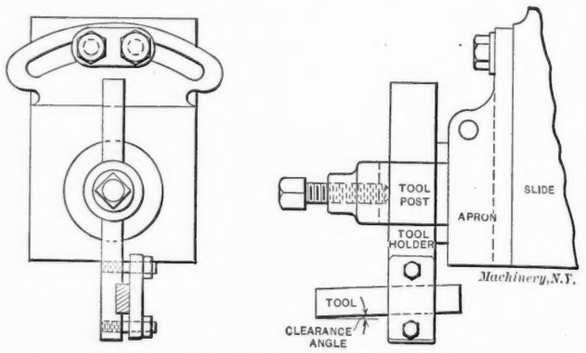


Fig. 1. Adjustable Extension Tool-holder with Tool.

the operation shown in the half-tone; that is, the cutting of a $\frac{5}{8}$-inch rack seat in the sliding head of a sensitive drill press. The construction of the tool is clearly indicated in Fig. 1, and the adaptability of this simple holder is easily seen, the machinist no doubt finding ample opportunity for using this tool for many purposes on planer and shaper work. The steel used for the tool itself is Novo high-speed steel. It will be noted that the clearance angle at the bottom of the

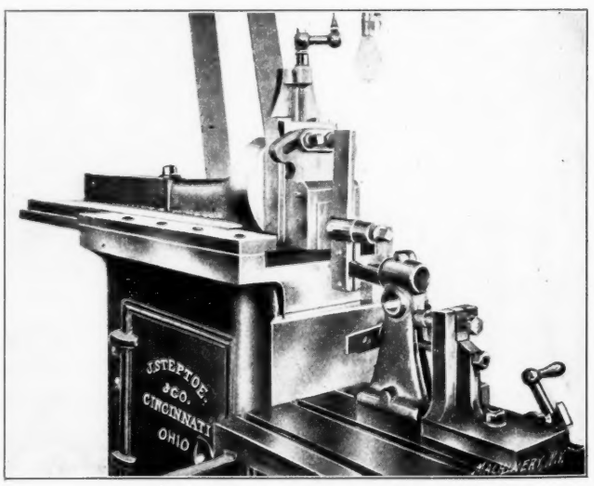


Fig. 2. Class of Work to which the Holder is adapted.

tool is obtained by the angle at which the tool slot is cut in the holder. The tool-holder shown has given excellent results for heavy work, is exceptionally rigid, and, being provided with facilities for the adjustment of the tool, avoids unnecessary over-reaching. Tools of different widths and thicknesses may be applied to it. DIETZ.

TURNING SOFT RUBBER.

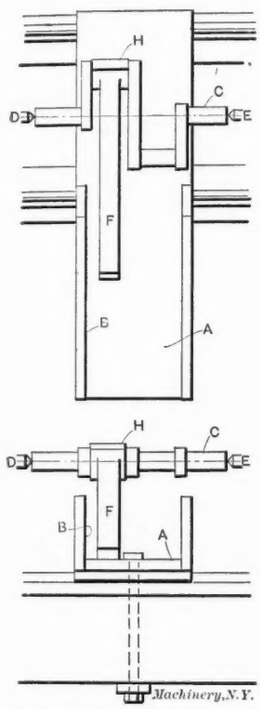
Replying to the question of "L. M." in the December issue of MACHINERY, relating to turning soft rubber, I would say that whenever the shape will permit, soft rubber can best be turned upon a wooden arbor, there being a tendency towards slipping when an ordinary steel arbor is used. A simple though excellent method of getting the hole for the arbor or of putting

holes in soft rubber for any purpose, is to notch the end of a piece of brass tubing whose outside diameter is the size of the hole desired. This piece of tubing is then used as a drill, and it will cut a clean hole slightly under the size of the tubing. When notched right, the end of the tubing should appear like the edge of a saw, although no clearance or setting is necessary. For a cutting tool, use an ordinary side tool ground with lots of clearance and to a *knife edge*, and this should be set the same as any side tool, but fed like a diamond point tool on a straight cut. After turning, the rubber may be smoothed by the use of sand paper or emery cloth. As regards lubrication, water may be used to good advantage, but the rubber should cut very good without any lubricant.

Lynn, Mass. CHESTER L. LUCAS.

FIXTURE FOR TESTING PARALLELISM OF CRANK-PINS.

The accompanying sketch represents a fixture for testing the parallelism of crank-pins on the crank-shafts of air drills and small, high-speed gasoline engines. It consists of an angle-plate *A* that has grooves that match the ways of a lathe. This angle-plate is clamped to the bed of the lathe, and, by means of the lathe bed, the plane of face *B* of the angle-plate is held at right angles to the axis of the lathe. The crank *C* whose crank-pins are to be tested is placed between the lathe centers *D* and *E*, as shown, and the arm *F* is fastened to one of the pins. The opposite sides of *F* are parallel and perpendicular to the adjacent sides, and the end *H* is similar to the end of a connecting-rod. To test a crank-pin for parallelism, the crank-shaft is moved through different angles, and if the pin is parallel with the crank-shaft axis, arm *F* will be parallel with the face *B* of the angle-plate. If the pin is not parallel, the amount it is out can be detected with a pair of inside calipers.



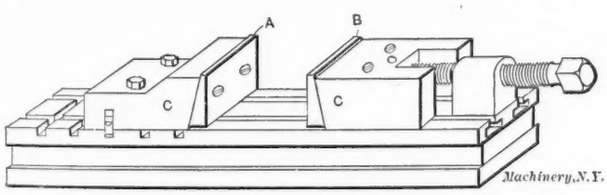
Plan and Elevation of the Fixture for Testing Crank-pins.

JOHN B. SPERRY.

Aurora, Ill.

A DRILL PRESS VISE.

The drill press vise shown in the illustration is "home-made," and one that I used for a number of years. The construction of the vise is simple, and it is almost indispensable for holding small work in the drill press. By referring to the illustration it will be seen that the jaws *A* and *B* are tapering on the back, and also that there is a slight space between them and the vise bed. The jaws are held up by springs, located within the blocks *C*, which bear against nuts attached to the jaws. These nuts fit into T-slots in the blocks *C* and keep the jaws in place. When a piece of work to be drilled is placed in the vise and the jaws are brought to bear on it, the pressure causes them to move downward, thus bringing the work down solid on the parallels with a positive downward pressure; whereas the ordinary vise jaws tend to spring or draw the work away from the parallels, even when it is rapped with the hammer. The jaws and their holders are square with the bed of the vise, and, as the vise is finished square all over, it can be used on the edge, end, or in the usual position.



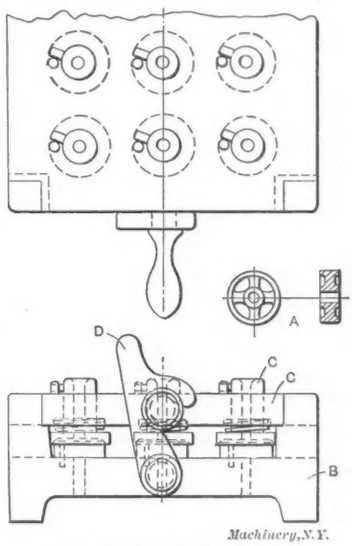
A Drill Press Vise with Jaws that move Downward when Work is clamped between them.

A. J. DELILLE.

Elgin, Ill.

MULTIPLE JIG FOR SMALL PULLEYS.

We have large quantities of the rough gray iron pulleys, shown at *A* in the engraving, to drill, and so made the jig, a half plan and end elevation of which is shown. This jig is used on a twelve-spindle multiple drill, and in the end view the work can be seen in position. The jig consists of the gray iron base *B* into which is fitted the gray iron cover *C*. The cover *C* holds twelve steel bushings with their ends cupped to center the work. A coiled spring is placed between the cover and bushing to take up any variation in the work. The cover is not hinged to the base as is common with jigs of this style, but is held by latches *D*. By swinging the latches off the handles of *C*, the cover may lifted off out of the way and the base emptied of the chips and work at one time. We found this jig very handy and accurate.

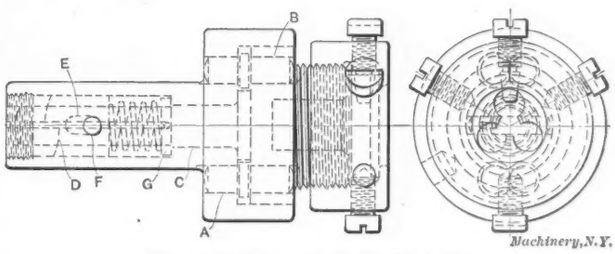


Jig for Drilling Small Pulleys in a Multiple Drill.

P. F. SETAG.

RELEASING BUTTON-DIE HOLDER.

The accompanying illustration shows a button-die holder of the releasing kind designed to work on the Brown & Sharpe automatic screw machines. It gives especially good results where the spindle cannot be made to reverse accurately, or where the die is working up to a shoulder.



Improved Design of Releasing Die-holder.

At *A* and *B* are shown the releasing pins which hold the die rigid while the work is being threaded. The spindle reverses when the die is at a certain fixed distance from the shoulder, but before the spindle can complete its reversal, the holder threads right up to the shoulder. The pins *A* and *B* are then disconnected, allowing the spindle *C* to rotate freely.

The spindle is now rotating in the reverse direction when after one-half revolution of die holder the clutch teeth at *D* engage and allow the die to be drawn off the work. The slot shown at *E* is cut in one of the engaging clutches, and the pin *F* is a drive fit in spindle *C*. The diameter of the wire in spring *G* should be from 0.023 inch to 0.032 inch, depending on the pitch of the die used; a die with a fine pitch would not work well with a stiff spring. By the insertion of the washer *G* it will be noted that the spring rotates freely with the spindle and is not subjected to any twisting moment, as it would be if it were in contact with the shoulder in the stationary part of the tool.

THOMAS J. NORTON.

Montreal, Canada. DOUGLAS F. HAMILTON.

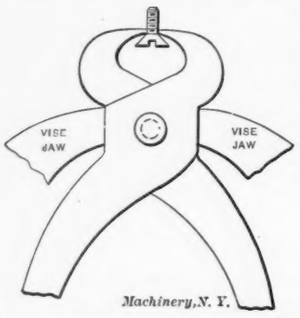
SHOP KINKS.

PRACTICAL IDEAS FOR THE SHOP AND DRAFTING-ROOM.

Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

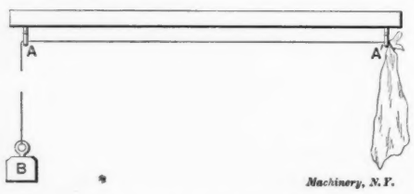
HOLDING SMALL SCREWS WHILE FILING OFF THE POINT.

The kink indicated by the accompanying line engraving may be of interest and service to some of the readers of MACHINERY. Some short screws, with bevel heads, were a trifle too long, and were to be shortened by filing off the point. The engraving shows plainly the method of holding the screws while filing. Holding them in this way neither injured the heads of the screws nor the thread. C. F. EMERSON.



ATTACHING INK RAG TO DRAWING BOARD.

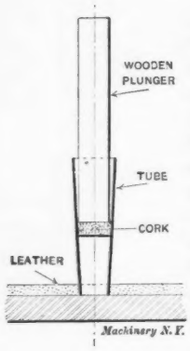
Although the ink rag may be one of the minor details in a drawing room, it is nevertheless universally used. The method of fastening it to the drawing board as shown in the engraving, is much better than the usual permanent fastening. A string passes through two screw-eyes *A*, one at the front, the other at the back of the drawing board. The



ink rag is tied at the front end of this string, while at the other end is a small weight *B* which returns the rag, after being used, to its proper place at the left of the board. If the draftsman is at the right end of the board, he needs but to reach for the rag, use it and let go, which is ofttimes very convenient. WINAMAC.

METHOD OF INSERTING CORKS IN FRICTIONS.

The accompanying engraving illustrates a method of inserting corks in frictions. The friction in question was lined with leather, 3/8 inch thick, and corks 7/8 inch in diameter were pressed into holes 5/8 inch in diameter. The taper tube shown was four inches long, about one inch in diameter at the large end, and the small end just small enough to fit in the hole punched in the leather. The corks were first soaked in some fairly warm water, after which they were pressed into place with the wooden plunger indicated.



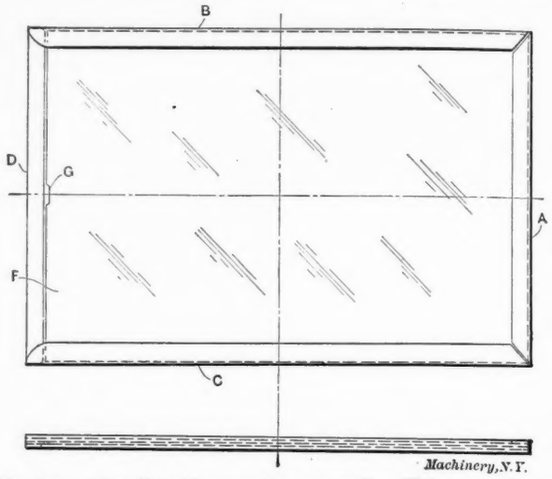
Aurora, Ill. JOHN B. SPERRY.

BLUE-PRINT PROTECTOR.

A simple way of protecting blue-prints from being destroyed when sent out in the shop, or when otherwise handled to a great extent, is shown in the accompanying illustration. The protector consists of a sheet iron frame with the edges *A*, *B*, and *C* bent over as shown. The side *D* is left open for the insertion of the print. This side, however, is turned over and hammered down, forming a stop or holder for the print, preventing it from slipping out. On top of the print is placed a sheet of transparent celluloid *F*. A little notch is made in the celluloid at *G*, permitting of getting hold of the blue-print under the sheet for pulling it out. By using this protector many blue-prints will be saved from premature destruction. L. H. GEORGER.

Buffalo, N. Y.

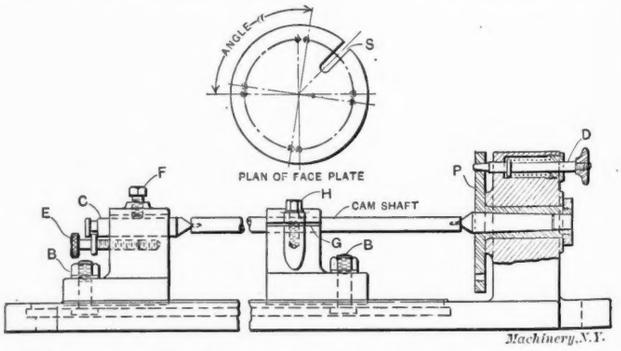
[The method proposed by our correspondent for protecting blue-prints may undoubtedly be of value in some cases, but for ordinary shop use it would be rather expensive, because large celluloid sheets are rather high priced. The cheapest and simplest way of protecting blue-prints is to mount them on bristol board, and varnish them with some kind of high grade varnish. There is one objection to this manner of protecting the prints and that is that if the varnish becomes scratched, it is then sometimes difficult to discern the figures and lines under the scratched portion. The same, however,



holds true of celluloid covering as well. This covering will easily become scratched in the shop, and when celluloid is badly scratched it is equally difficult to see the object under it plainly, and at the same time it is impossible to restore it to its original condition.—EDITOR.]

GAS-ENGINE CAM-SHAFT KEY-SEATING FIXTURE.

This fixture is used for milling key-seats in the cam-shaft of a four-cycle, four-cylinder gas engine, with both exhaust and inlet valves on the same side, and actuated from one cam-shaft. The fixture consists of a cast iron base and head-stock, a movable tail-stock, and a steady-rest, which clamps the cam-shaft and holds it firmly in position while the cutter is milling the key-seat. A plan of the face-plate *P* is shown in the illustration. The slot *S* receives the tail of a dog, which is fixed to the cam-shaft. The indexing holes are laid out the required number of degrees apart, depending upon the angle of action of the cams. The angle *a* should be one-half the angle of action of the exhaust cam, plus one-half the angle of action of the inlet cam, plus one degree. This allows two degrees travel of the crank-shaft from the time the exhaust closes until the inlet opens. The face-plate is locked in position by the spring-plunger *D*, the end of which fits into tapered holes to insure a perfect fit. The center *C*, in the tail-stock, is operated by the screw *E*, and



is flatted on top for the set-screw *F* which locks it. Both the tail-stock and steady-rest are held in place by the bolts *B* and *B*, which slide through the T-slot in the base. The bearing in the steady-rest, that the cam-shaft slides through, is slotted at *G*, thus allowing the bolt *H* to clamp the shaft. An ear is cast on each end of the base, and is slotted to receive the holding-down bolts; two are sufficient as the cut is light. W. A. SAWYER.

NEW MACHINERY AND TOOLS.

A MONTHLY RECORD OF APPLIANCES FOR THE MACHINE SHOP.

IMPROVEMENTS IN THE NO. 2½ BATH UNIVERSAL GRINDING MACHINE.

A Bath universal grinding machine of an older type was described in the March, 1905, issue of MACHINERY. The improved design which we herewith illustrate has the same general construction. The table is mounted on a bed which is adjustable to any required angle about a bearing on the top of the base; the wheel spindle is mounted in a head vertically adjustable on a column at the back of the machine; the spindle is driven by a counter-shaft idler which adapts itself to the change in the position of the spindle pulley due to the vertical adjustment; and a very complete set of attachments is provided adapting the tool to grinding of any kind, from the sharpening of the cutters, reamers, etc., to cylindrical grinding, both external and internal, and surface grinding. The most noticeable improvements are the provision of improved automatic feeding apparatus for cylindrical and surface grinding, the new design of the wheel spindle-head, and the provision of the new attachments for doing certain classes of work more conveniently and expeditiously.

Fig. 1 shows the machine as a whole, its general arrangement being as just described. Fig. 2 shows the apron which is provided with two separate power cross-feeds, in addition to the original automatic reversing longitudinal feed. One of these cross-feeds,

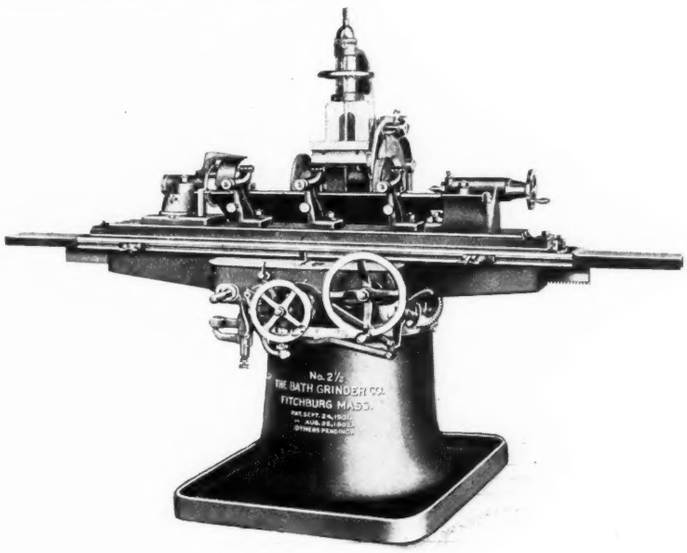


Fig. 1. The Improved No. 2 1-2 Bath Universal Grinder.

acting on the ratchet dial on the left, gives minute movements, and is used for cylindrical grinding; it is provided with an automatic stop for sizing the work. This dial is geared with the cross-feed screw to give the required sensitiveness of movement. The link motion operating the double ratchet and pawl movement on the cross-feed screw at the right, gives the coarser feed required for surface grinding. This feed operates at each end of the traverse, is reversible and may be effected at one or both ends of the stroke as required. The cylindrical cross-feed may be made as fine as 0.0002 inch per stroke, while that of surface grinding from 1/64 to 3/32 for each stroke of the table. The reversing mechanism is positive so that work may be ground close to a shoulder. The table slide is controlled by a single lever which reverses the feed in either direction, and starts or stops the traverse movement. By turning the handle at any point of the movement, the table will be stopped at the end of the stroke. The cylindrical grinding feed acts at each end of the table stroke, and the power for operating it is taken from the mechanism that reverses the table slide, through the compression swivel plunger shown below the large knurled knob in the center of Fig. 2.

Fig. 4 shows the improved spindle-head, rigged up with the various attachments furnished for it. At *A* is seen the plain head. The finished bright surface at the end of the spindle bearing is for convenience in using a square or bevel protractor in setting work or attachments on the machine. Clearances in cutter and reamer grinding, and the setting of the wheel with relation to the work, are measured by the combined elevating screw and sliding graduated

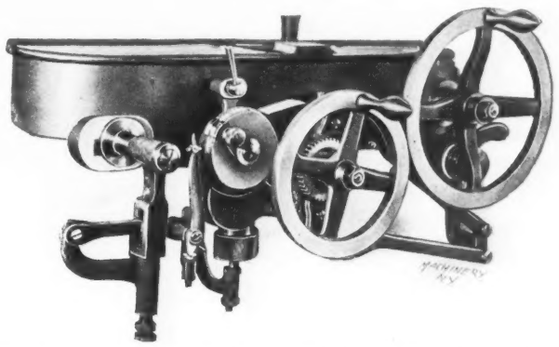


Fig. 2. Apron of the Grinder Provided with Two Cross Feeds, One for Cylindrical and the Other for Surface Grinding.

rod, together with the revolving dial on top of the machine. These give the micrometer readings. At *B* an extension arbor support for the wheel is shown attached to the head. This is used in surface grinding, sharpening form-cutters, finishing snap gages, and on similar work where a large overhanging of the wheel is desirable. At *D* is shown the method employed for clamping the various forms of tooth rests to the spindle head. The same screws are used as in clamping the overhanging arm in *B*. It should be noticed that the rests can be brought to the cup or disk wheel either from above or from below. At *E* is shown the head as arranged for plain cylindrical grinding, with a wheel hood and the makers' "Wizard" water spout. This water spout is of a peculiar design, which will furnish water a drop at a time or in full stream, without any spattering caused by the air blast from the wheel.

At *C* is shown a head as arranged for internal grinding. The arm which supports the internal spindle is mounted in a suitable seat at the base of the spindle column. The belt may be tightened while the machine is in motion by a vertical adjustment of the regular spindle head. In Fig. 3 are shown various internal grinding spindles, made with detachable flanged bearings. These spindles are made in different lengths and diameters to suit the character of the work being ground. That at the left is used for internal grinding of the heaviest character.

In Fig. 5 is seen another of the new attachments. This is a universal holder mounted in the tail-stock. It is shown grinding the side teeth of a side milling cutter, using an 8-inch cup wheel. The hinged plunger tooth rest should be noticed. In chang-

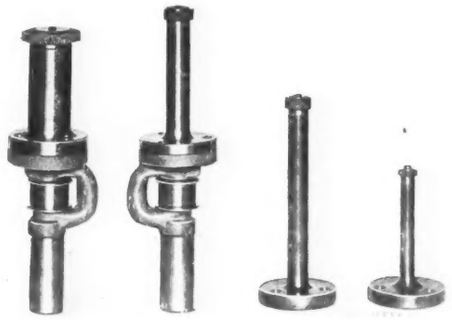


Fig. 3. Type of Internal Grinding Spindles used, carried in Detachable Flanged Bearings.

ing the angle, the cutter and tooth rest are adjusted at the same time, both being mounted on the same support. In sharpening this cutter, the tooth is reciprocated by the handle shown, it being un-

necessary to operate the table. In Fig. 6 is shown the same attachment engaged in grinding a large gear cutter. The machine is rigged for supplying water to the wheel during this operation. The use of the "Wizard" nozzle makes unnecessary the provision of water shields to keep the machine dry. The same tooth rest is being used as before. The other attachments for this machine, such as the universal holder, horizontal vise, flanged plate, etc., are the same as described in the article previously referred to.

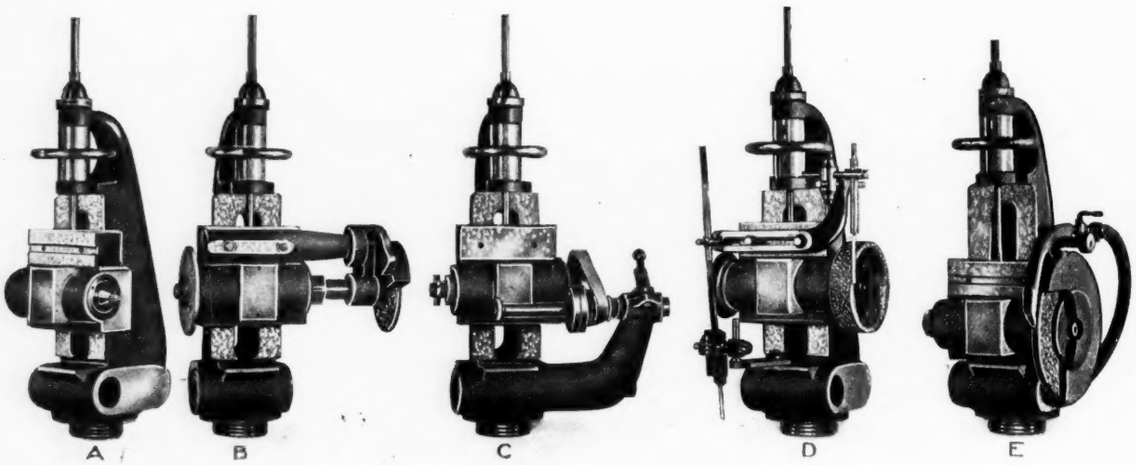


Fig. 4. Spindle Head of the Bath Grinder, Rigged for Various Operations, such as Cylindrical, Internal, Surface and Cutter Grinding, etc.

For external and internal cylindrical grinding, the machine is provided with a suitable head-stock and tail-stock, and with water guards, so as to make it an efficient tool for this work, free from the makeshift attachments often found on a universal tool-room machine. The head-stock swivel is graduated, and the swivel bearing is dust-proof. A dowel pin is provided for setting the swivel adjustment in a central position. The clamp nut and the swivel binding nut are both in the center of the head-stock and are independent of each other. The dead center pulley revolves on a conical bearing at the end of the quill, and is held in place by a detachable flange. The quill is so constructed that it can be used for either revolving or dead center grinding. The foot-stock has a spring center. It carries on the front end a flat projection for clamping a diamond holder for truing a wheel, or for clamping tooth rest stands for cutter grinding. Spring rests are used for absorbing vibration and supporting the work in shaft grinding. The supporting pressure on the shaft is relieved when the required diameter is attained. A hand tension screw is also furnished which keeps the supports up beneath the work and assures a rigid bearing. Suitable water shields for wet grinding are provided.

This grinder can be furnished by its maker, the Bath Grinder Co., Fitchburg, Mass., in any one of a number of styles for different classes of work, depending on the equipment sent with it. For instance, it may be furnished for plain, surface, internal, disk, and cutter grinding of all descriptions, or for any combination of these various purposes.

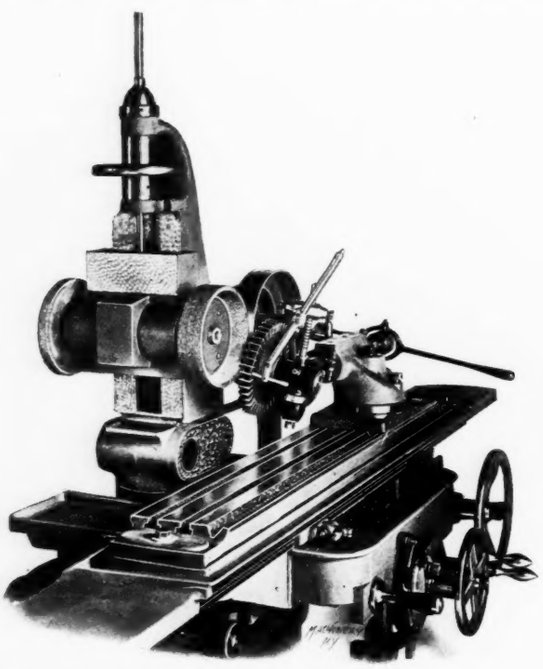


Fig. 5. Grinding Side Teeth of a Milling Cutter with a Universal Holder Mounted in the Tail-stock.

OESTERLEIN NO. 3 UNIVERSAL AND TOOL GRINDER.

This machine, like previous machines built by the same maker (the Oesterlein Mch. Co., 2850 Spring Grove Ave., Cincinnati, Ohio), is similar in its structural design to the column type of milling machine—that is to say, the work table is fed longitudinally on a saddle, which in turn has a cross adjustment on a knee; this knee is vertically adjustable on ways on the face of the column. This new design, however, bears little resemblance to its predecessors. While intended for the regular work of the cutter and reamer grinder, it is arranged as well to do cylindrical and surface grinding in a rapid and satisfactory manner, being provided with a full equipment of automatic feeds, work revolving connections, water guards, etc. The principal improvements so far as structural features are concerned relate principally to the provisions for wet grinding,

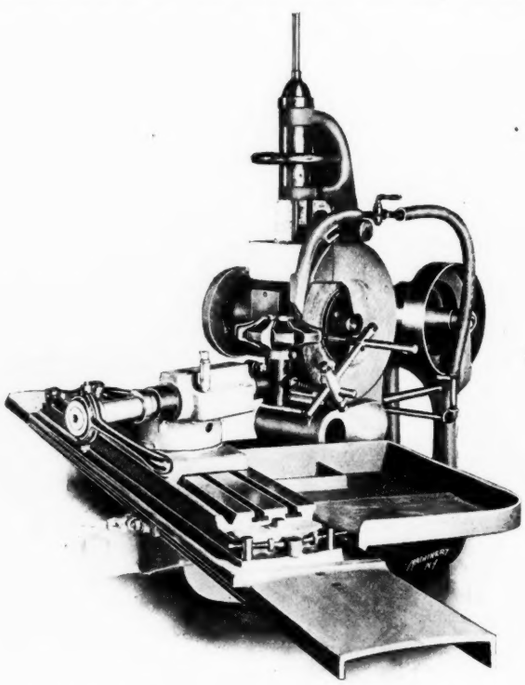


Fig. 6. Universal Holder Engaged in Grinding a Large Gear Cutter.

the elaborate safe-guarding of the sliding surfaces from emery dust, and the general strength and rigidity of the whole machine.

The spindle head is mounted on the top of the column, and may be swiveled in position about a vertical axis. This swiveling adjustment is read from graduations. This head is provided with a self-contained splasher and drip trough, as best seen in Fig. 1, which catches water thrown from the revolving work and leads it back into the channels provided for returning it to the reservoir. The spindle is driven by a two-step pulley, giving two speeds for the wheel.

The table bears on the saddle or cross slide for its entire length. The upper member of the table can be swiveled to any angle throughout the full circle, and clamped in any position when so swiveled. For grinding comparatively small tapers, a scale is provided reading in inches per foot. Fine adjustments for such tapers are obtained by a worm meshing with worm-wheel teeth cut in the right hand end of the table in Fig. 1. The slide has V and flat bearings on the saddle, and the saddle has similar bearings on the knee, thus insuring accurate alignment at all times, preserving the longitudinal and cross movement exactly at right angles to each other. The table comes down over its bearing on the saddle on all sides, thus protecting these parts. The bearing of the saddle on the knee is protected, as shown in the front view, by a guard which is supported in the rear, and passing entirely through an opening provided for it in the saddle, covering the ways under all conditions.

The head-stock is provided with swiveling adjustments to any angle in the vertical or horizontal plane. The tail-stock has a spring center, and is actuated by a lever when placing or releasing the work. The vise furnished for surface grinding may be mounted on the head-stock angle support, in which case it can be set to any angle in two planes. This vise may be used for holding round work, as a V-block is provided for its lower jaw. The upper jaw swivels to accomodate any taper; the vise has a back-stop as well, making it convenient for holding straight and taper shank mills for grinding, when they cannot be conveniently held on centers or in collets. The tooth rest provided is universal, and has a micrometer adjusting

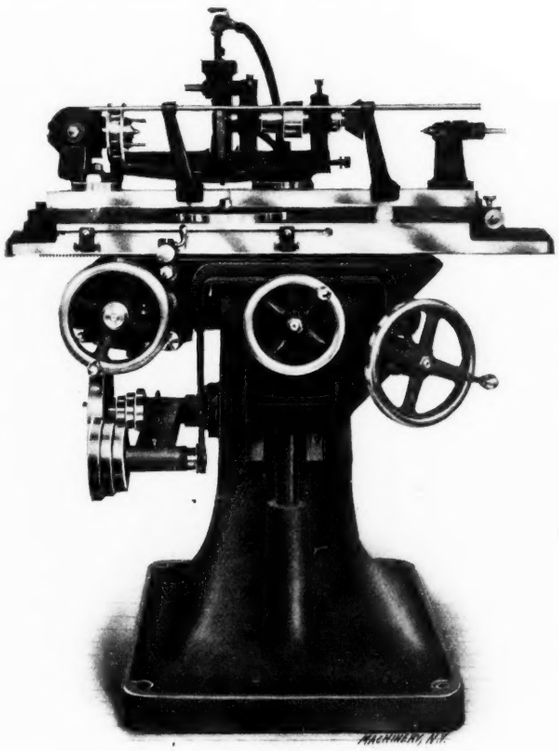


Fig. 1. Front View of the Oesterlein Universal Grinding Machine, showing Protection of Sliding Bearings from Emery Dust.

nut for accurate setting in any position. Back rest and splash guards are provided for cylindrical grinding. One of the latter is shown in place in Fig. 2.

Besides main counter-shaft for driving the spindle, pump, and feed, there is a supplementary drum counter-shaft for revolving the work in cylindrical grinding. But one belt shifter is needed, as provision is made for starting and stopping the drum counter-shaft by tightening or loosening the belt which connects it with the main counter-shaft. This movement, as may be seen in Fig. 3, is effected by mounting the hangers on pivots and swiveling them by the worm shown, connected to a rod extending downward within reach of the operator. The loose pulley used on the main counter-shaft is shown in Fig. 4. It has a cored chamber, which,

Fig. 2. Side View of Oesterlein Grinder showing Provision for Wet Grinding.

when filled with wicking, will retain sufficient oil for a long run. Mounting the pulley on a bushing protects the shaft from cutting or wearing.

The equipment of this machine includes a 4-inch chuck, a vise, head-and tail-stocks, tooth rest, centering gage, extension spindle, raising blocks, internal grinding attachment, seven steel bushed emery wheels of various shapes, the necessary wrenches, the main and drum counter-shafts, a set of dogs in a tray, and a steady rest. The automatic table feed is 16 inches in length, the transverse movement is 8 inches, and the vertical adjustment is 7½ inches. The swing between centers is 9 inches. When raising blocks are used, this is increased to 12 inches. The 6 rates of table feed provided range from eight to fifty revolutions per inch. The net weight of the complete machine is 1,400 pounds.

NEWTON DUPLEX FACE MILLING MACHINE.

A duplex milling machine designed for heavy face milling, or rotary planing of parallel perpendicular surfaces, is shown herewith. This machine is built by the Newton Machine Tool Works, Inc., Philadelphia, Pa. It is noticeable for its rugged design, and the very convenient arrangement of operating the handles and other controlling devices.

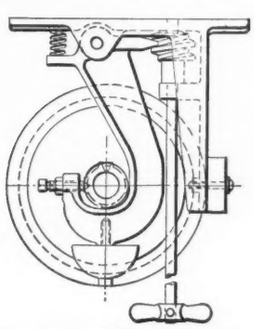


Fig. 3. Belt-tightening Hanger for Drum Counter-shaft, which avoids the use of a Belt Shifter.

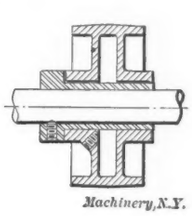
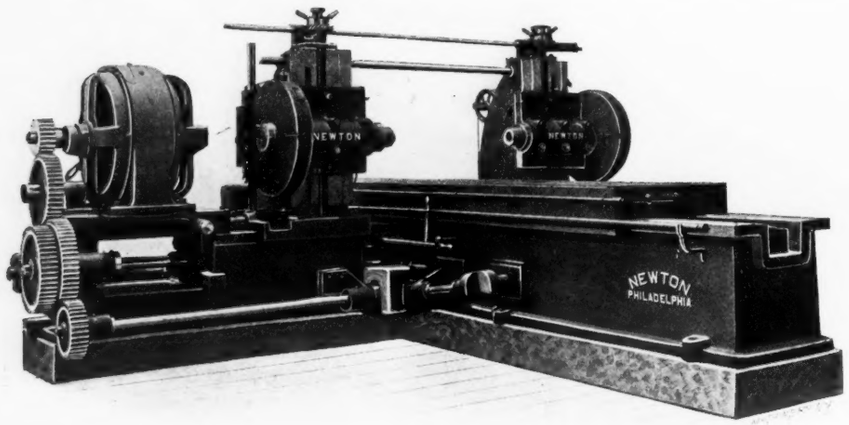


Fig. 4. Loose Pulley used on Main Countershaft; the Core is filled with Wicking.

The machine consists essentially of a long bed on which slides the work table, and is provided with two wings on which columns

are adjustably mounted, carrying vertical, adjustable spindle heads. These spindle heads may be adjusted either separately or together, the latter provision being useful if the machine is to be used for slab milling.

A 35 H. P. motor furnishes the driving power. From the armature shaft, the motion is transmitted through a train of gears, to the horizontal driving and feed shafts. On the latter is mounted a double train of miter gears, running loosely on the shaft, to which either may be connected by a double throw Carlyle-Johnson friction clutch. This is seen in the angle of bed in the illustration. This movement is further transmitted through miter gears to a feed



Double Horizontal Face Milling Machine for Heavy Work.

box on the other side of the machine, where nine rates of feed are obtained. These feeds range from 0.789 to 8.15 inches per minute at the high speed of the motor, and from 0.394 to 4.08 inches per minute for the slow speed of the motor. Motion is taken from this feed box shaft of the machine, which is connected at the rear through worm gearing with the feed pinion of the table. This horizontal shaft may also be driven through quick acting spiral gears on the horizontal drive shaft by means of the positive clutch shown, which thus serves to connect either the slow feed or the fast traverse.

In the rear of the right hand ring a connection is made from the horizontal feed shaft for slow feed or quick adjustment for the spindle heads. Independent simultaneous movement for these is obtained by adjusting the friction clutches shown at the top of the up-rights. The shaft connecting these may be operated by hand for minute hand adjustment. The table may be clamped in position so as to use the verical feed in a face milling operation.

All the operations of this machine with the exception of the change in the rate of speed can be controlled from either side. This applies to the change from feed to fast traverse or vice versa, and to the reversing of the feed. The vertical and horizontal feed throw-outs are likewise provided with handles on either side.

The panels on which the uprights are mounted are of very solid construction, and are provided with key slots cut from the solid, which permits clamping the uprights securely in position with four bolts each. With this provision the adjusting gibs can always be kept loose for a free running fit. Additional spindle speed changes beyond those given by the two to one variation in the motor are provided for by change gears in the train connecting the armature shaft with the spindle driving gears.

The spindles of this machine are 6 inches in diameter, and are driven by steep lead bronze worm-wheels 33 inches in diameter and hardened steel worms running under continuous lubrication. The spindle heads are counter-weighted, and may be adjusted from 5 to 26½ inches above the table. The uprights have an in and out hand adjustment from a minimum of 30 inches to a maximum of 60 inches between the ends of the spindles. The heavy work table is 42 inches wide, and 15 feet 6 inches long, with a capacity to mill 14 feet in length. It is entirely surrounded by an oil pan fitted with a lubrication system, arranged to drain into a storage tank in the rear of the machine. The oil or water is returned to the cutters by a pump located at the back of the left hand wing. The table is driven by a steel rack and bronze spiral gear.

CINCINNATI PLANER ARRANGED FOR USING EXTENDED TOOLS.

The accompanying illustrations show a planer built by the Cincinnati Planer Co., Cincinnati, Ohio, provided with specially designed tool supports, which allow a great overhang of the tool without loss of stiffness or cutting power. While the planer was originally intended for the particular work of machining locomotive cylinders, the construction is one which can readily be adapted to any work in which a great overhang of the tools is required.

Fig. 1 shows the supports as arranged on the planer. Fig. 2 shows the detailed construction of the added parts. The machine itself, with the exception of the side heads, is the regular planer as arranged for parallel drive. The housings *A* have ways planed on them on the inside, each provided with a dove-tail front surface, and a square surface in the back. In these ways fit brackets *B*, which are counter-balanced with a weight and chain. The use of the chain allows them to be raised and lowered by a crank applied to the sprocket wheel. The brackets are secured to the housing by tightening the taper gib on the straight side. This forces the bracket against the dove-tail, and draws it in against the bearing.

The front end of *B* has a rectangular section, which is machined and scraped parallel with the front face of the housing. On this is fitted a shoe *C*, having a dove-tail on the opposite side, which fits the cross-slide of the special side heads *D*. After the slide is

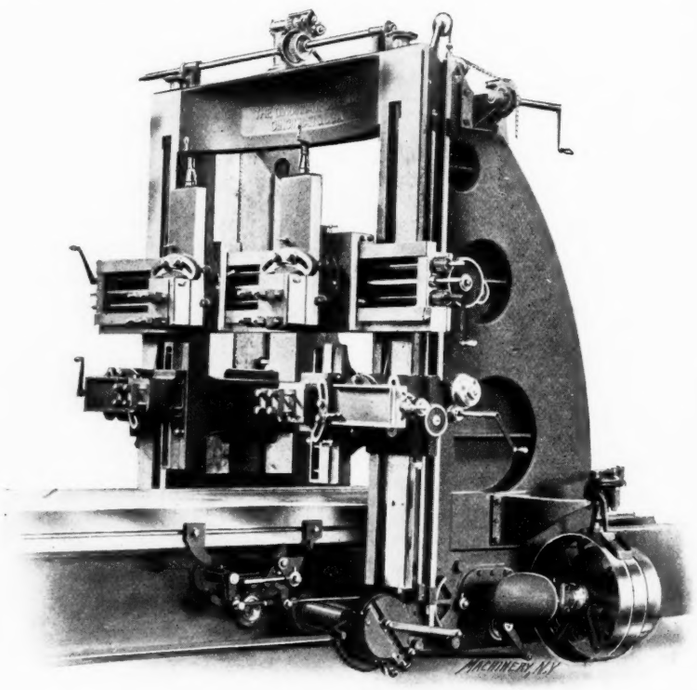


Fig. 1. Cincinnati Planer, with Bracket Supports for Extended Side Heads.

run onto this shoe, the latter is adjusted to the bracket by the two taper bearings, seen best in Fig. 1. When this has been done, the shoe is a part of the side head, and the two move up and down together, the shoe sliding on the bracket. When it is necessary to reach out 24 inches from the housing with the tool, the latter is supported by the bracket, which extends out about 18 inches, as rigidly as if it were mounted close to the housing.

The bracket *B* is made of such a length as to clear the projections

on all sizes and makes of locomotive cylinders and yet have enough bearing so that shoe *C* would never extend over the bearing on the bracket. Fig. 2 shows, in dotted outline, one of the most difficult of the cylinders the planer is intended to handle. This diagram illustrates very plainly the advantage of supporting the tool, when it is necessary to reach out so far to get at the work as is required in piston valve cylinders of this design. When the planer is to be used for other purposes than this special work, the slide can be run back on the side head, as usual, and the brackets raised up out of the way. The machine then becomes an ordinary 72-inch x 72-inch x 18-foot planer, with its full capacity available.

BECHE PNEUMATIC POWER HAMMER.

The illustration shows a "pneumatic power hammer" as it is termed, which is well known in Europe, and is being made and sold in this country by the Nazel Engineering and Machine Works, Philadelphia, Pa. In this machine many of the advantages of the power and the steam hammers are combined. Briefly, the construction comprises two cylinders, one of which contains a piston

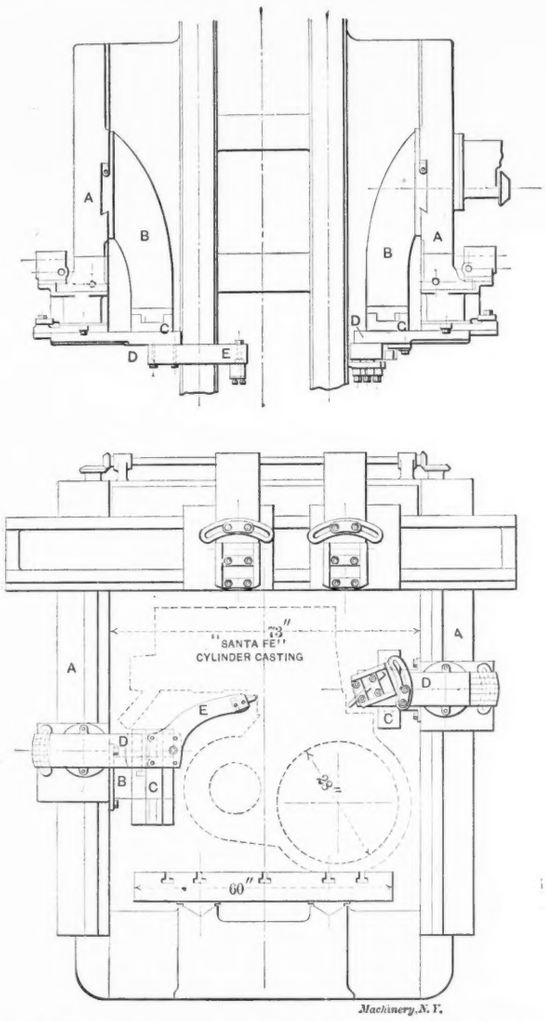
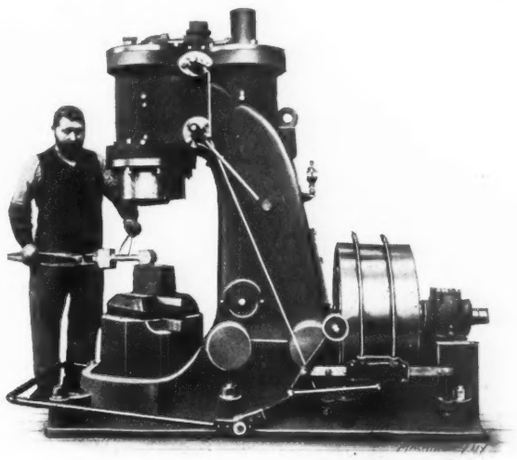


Fig. 2. Plan and Elevation of Special Planer Attachments, showing Use on a Difficult Job.

worked by a crank and connecting rod, while the other carries the striking ram or plunger. The latter is reciprocated by the alternate compression and vacuum produced by the power operated piston.

The construction of the hammer is very simple. The frame is made in a single piece, bolted to the bed-plate; the anvil block is separate. The power crank shaft has mounted on it, a heavy fly-wheel and it may be arranged to be driven either by belt power or by electric motor. The ram or hammer head in the other cylinder slides vertically on closely fitted guides. The whole mechanism is enclosed, so that no destructive forging dust or other foreign matter can reach the working parts. All the movable parts and both the cylinders are lubricated automatically. The hammer is easily operated, and by means of the air regulating valves it is possible to hold the ram suspended at any height, and to instantly change from a very light blow to a heavy one. On closing the valve, the ram remains immovable in its highest position. Suitable connections are made so that fresh air is admitted at every stroke, thus preventing the hammer from being overheated. The operating levers are so arranged that the workmen can control the machine and handle his work at the same time.

The uses of this hammer are numerous as it fills the requirements for general smithing and forge work. A large variety of work which is done on drop hammers can also be effected under the Beche hammer with great rapidity and accuracy. It is especially adapted to the welding and forging of axles, shafts, etc.

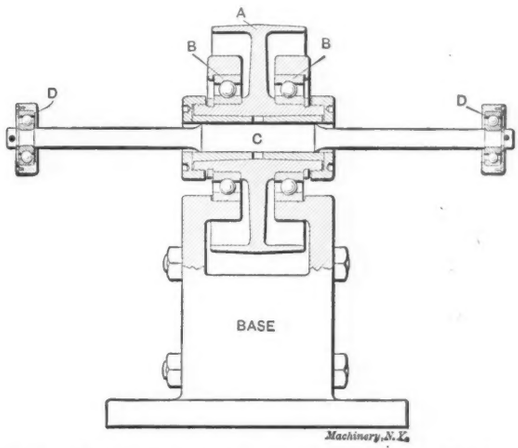


A Pneumatic Hammer, operated by a Direct-connected, Power-driven Air Cylinder.

The claims for this hammer are: Simple and rigid construction; easy adjustment; a quiet but forcible squeezing blow; lack of jar or vibration to the operator; long ram guides; enclosed construction; suitable speed; minimum power; long stroke; belt or motor drive; automatic oiling; and separate bed, with a rigid anvil block. It will be furnished in seven sizes, ranging from 66 to 660 pounds for the weight of the ram. Over a thousand of these machines are in constant use on the Continent.

WHITE-SOUTHER ENDURANCE TESTING MACHINE.

Tinius Olsen & Co., 500 North Twelfth Street, Philadelphia, Pa. have recently placed on the market the White-Souther endurance testing machine, whose construction is shown in the accompanying line engraving. This machine is intended to give dynamic tests



Machine which tests the Endurance of a Specimen by loading it at its Ends and Revolving it.

of materials in a way which is at once convenient and effective. The deflection of the specimen is effected by a rotary, instead of by a reciprocating motion.

In the engraving, *A* is the driving pulley of the machine, mounted on ball bearings *B*. The hub of this pulley is provided with a split bushing arrangement for firmly clamping the test specimen *C*, which may be double ended, as here shown, or single ended only. The use of a double specimen has practically the effect of making

a check test; if a flaw exists in one end, the other end may be sound, so that a normal result is obtained. It should be noticed that it is possible to machine a standard tensile specimen from the central and unstrained portion of the sample after the dynamic test is completed.

The alternating strain is produced by rapidly rotating the specimen, which is weighted at its outer, or free ends. The loads are in the form of direct weights, supported on ball bearings *D*. A revolution counter is provided at each end to give the number of reversals of the strain in the test. The connection between the revolution counter and the end of the specimen is such that no damage results to the instrument from a sudden rupture of the specimen. 1300 revolutions per minute is the customary speed at which this machine is run in the laboratory of the inventors.

NEWTON CUTTER GRINDER ATTACHMENT FOR ROTARY PLANER AND FACE MILLING HEADS.

In the April, 1906 issue of MACHINERY, we illustrated and described a self-contained grinding attachment for automatically sharpening the blades in a rotary planer head. This attachment was designed by Mr. Riddell, and was used in the Schenectady

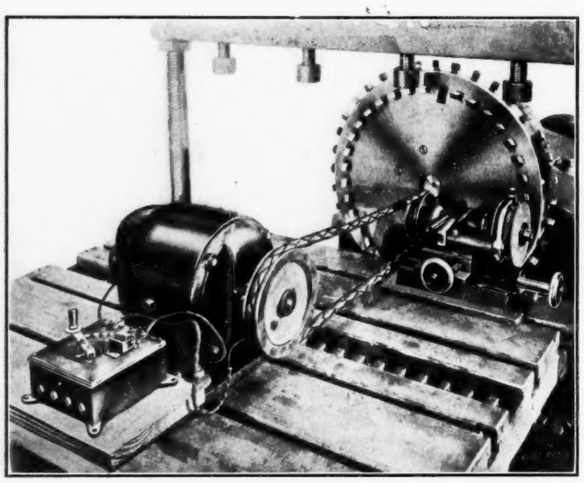


Fig. 1. The Riddell Portable Milling Head Grinder as built by the Newton Machine Tool Works.

shops of the General Electric Co. of which he is superintendent. In using it, the planer head was revolved slowly past the wheel, which ground each tooth as it passed by, and was swung in and out to give the proper clearance to the cutting edge. This machine is now being made in an improved form by the Newton Machine Tool Works, Inc., of Philadelphia, Pa., as shown in the accompanying half-tone and line engraving.

The wheel *A* has its outline formed to give the desired shape of cutting edge to the inserted teeth. It is mounted on carefully protected ball bearings at either end of the spindle, in a swinging

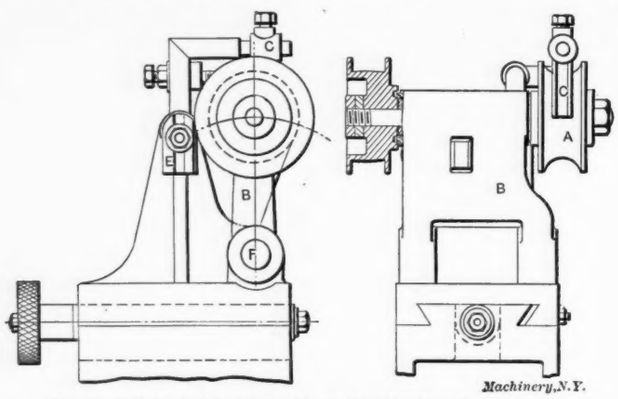


Fig 2. Details of Grinder Similar in Construction to that shown in Fig 1, but differently Mounted.

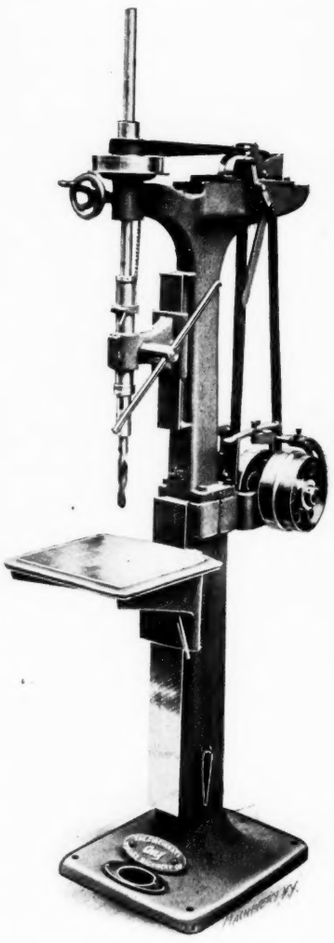
frame *B*, pivoted at *F*. The dog *C* extends over the wheel in line with the teeth, which strike it successively as they pass by. The swinging movement thus given the dog is transmitted through the rock shaft on which it is mounted to slotted link *E*, which engages an adjustable block in an arm cast solid to swinging frame *B*. By this means it will be seen that as the planer head revolves, each successive tooth operates the rock shaft in such a way as to force the wheel in to grind the clearance on each cutting edge, and bring it out again ready for the next tooth. The clearance is adjusted by shifting the position of the block along the solid arm on which it is mounted.

The slide carrying the spindle has an in-and-out adjustment of 3 inches, and a cross adjustment of 5½ inches. The motor shown is larger than necessary for the work, being a half horse-power direct current motor, running at 2,500 revolutions per minute. In using the device for grinding the teeth on a vertical spindle mill, (as illustrated in the description of the Newton four spindle milling machine, in the department of New Machinery and Tools of last month's issue of MACHINERY) finger *B* is adjusted to the opposite quarter. For grinding teeth that are too close together to permit withdrawing the wheel, a double pawl is provided, which permits skipping every other tooth.

The makers of this device have found it possible to double the feeds previously obtained, by grinding the blades in the cutter head in place. A smoother finish to the cut is also noticeable. A test on a vertical rotary planing machine recently made, after grinding the teeth with this attachment, gave a cut 14½ inches wide and ¼ inch deep, at a table feed of 8½ inches per minute, using a 10 H. P. motor.

AVEY SENSITIVE DRILL PRESS.

The sensitive drill press shown herewith is a new product of the Cincinnati Pulley Machinery Co., Cincinnati, Ohio. Aside from general good design and workmanship, some special features have been introduced in this machine; among them the driving arrangement will be particularly noted. Convenience, range, strength and speed are stated as factors sought for in the design.



The Avey Sensitive Drill Press.

The machine runs on ball bearings throughout. All the cones and balls are hardened and accurately ground, and have four point contacts. The spindles are of crucible steel, ground to size, and bored to fit the No. 2 Morse taper. The spindle sleeve is graduated, and is provided with a stop collet having a fixed clamp screw, requiring no wrench or screw-driver. This, in combination with the graduation, makes the use of a scale unnecessary in drilling to depth. The rack pinion and shaft for feeding are of one solid piece —an improvement over the usual separate construction. The upper and lower columns and the counter-shaft brackets are tongued and grooved, insuring proper alignment and interchangeability. If desired by the purchaser, the table will be fitted with a telescopic elevating screw, operated by bevel gearing, the construction being the same as that used in milling machines. This allows the maximum distance between the spindle and the table, and can be applied at any time subsequent to the purchase of the machine, though it is not furnished without extra cost.

The spindle has four changes of speed, which are instantaneously obtainable. A convenient handle shifts the belt on the two-step

cone pulley on the counter-shaft. Two more changes are obtained by shifting the quarter turn belt to one of two positions on the counter-shaft and spindle pulleys. To permit this shifting, the two quarter turn idlers perform different functions. The one at the left is adjusted longitudinally by the hand-wheel shown for tightening the belt to the proper tension. The idler at the right-hand side which leads the belt on to the spindle pulley, is raised or lowered to the proper position for either of the two speeds by means of the lever shown.

This machine has a spindle traverse of 13½ inches and a rack feed of 5⅝ inches. The maximum distance of the spindle to the table is 35½ inches. It is made as a single spindle machine, or with two, three or four spindles as required. The weight of the single spindle machine is 430 pounds, that of the four spindle machine is 1,220 pounds. The machine has a capacity for drilling up to 29/32 inch diameter.

VAN DORN ELECTRIC DRILL.

Fig. 1 shows the front view, and Fig. 2, a section of one of the new line of portable electric drills made by the Van Dorn Electric & Mfg. Co. of Cleveland, Ohio.

The motors for these drills are made in both open and closed designs depending on the conditions under which they are to work.

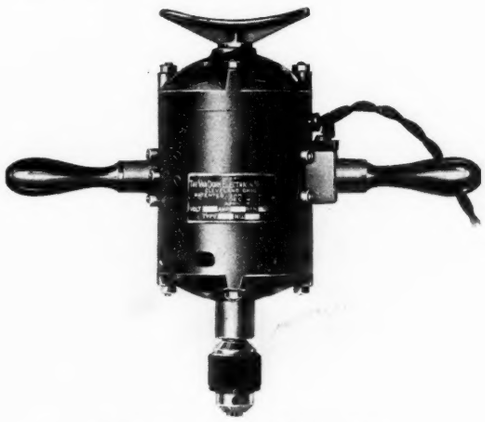


Fig. 1. The Van Dorn Electric Drill.

The example shown has ventilation holes in both heads, and in the sides of the machine. A current of air is forced through these holes by the peculiar design of the armature. The air is drawn in through the heads, and forced out at the sides, the current passing completely through the field opening at the air gap between

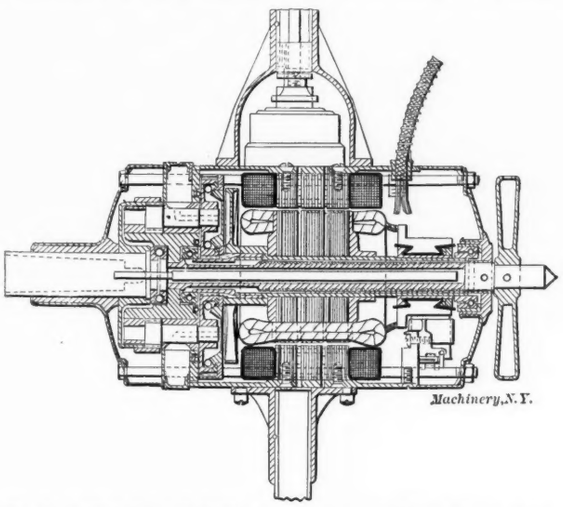


Fig. 2. Section through Drill, showing Use of Ball Bearings and the Provision for Cooling the Commutator, Armature and Field.

the pole pieces and the armature. The upper and lower thrust, as shown, is taken on ball bearings. All the bearings that are not ball bearings are made of phosphor bronze. The gearing and all other wearing parts are made of steel, case hardened.

The tools are controlled through a switch handle operated by a knurled ring. A quarter turn of this ring will stop the machine, which is thus, at all times, under the instant control of the operator. Each machine is equipped with an armored cable. The armor of this cable is grounded in the machine, absolutely preventing the operator from getting a shock.

These electric drills are built in five sizes; the smallest is equipped with a standard chuck having a capacity for any drill from the smallest up to a quarter inch in diameter. The other machines are fitted with Morse taper sockets, the largest size being bored for No. 4 taper and being capable of driving a 2 inch drill in steel. The design is the result of long experience, with a long and severe trying out in various establishments, all of which was done before the tools were placed on the market.

THE BEMIS HEXAGONAL MILLING MACHINE.

We show herewith an interesting automatic machine for milling hexagon flats on nuts, valve fittings, stuffing box glands, etc. It is a multiple spindle machine, with the work carried by an indexing spindle carrier, which leaves one station open to the operator for placing and removing the work. Except for this matter of placing and indexing the work, the machine is entirely automatic. It is built by Edgar W. Bemis, of Worcester, Mass.

The general arrangement of the machine is shown in Fig. 1, while Fig. 2 shows the details of the mechanism. The machine is driven by tight and loose pulleys on shaft *A*, which is connected by bevel gearing with the vertical shaft *B*, which extends up through the center of the machine. This shaft, in turn, is connected by bevel gearing in the cutter head *C* with the three cutter spindles *G*,

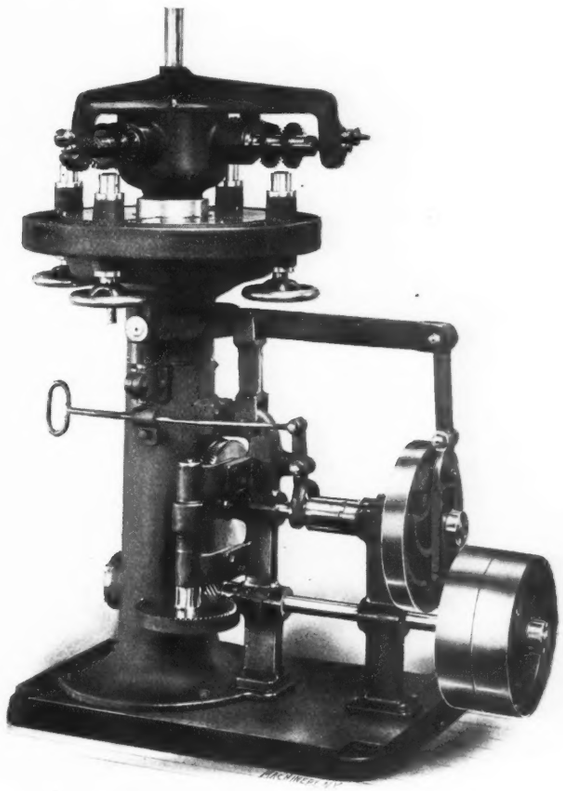


Fig. 1. A Machine for Milling Hexagon Surfaces on Valve Bodies, Nuts, etc.

which are placed at right angles with each other. These spindles are supported by outboard bearings in the overhanging arm *D*, which is clamped to cutter head *C*. This latter is raised and lowered to accommodate different lengths of work by means of a worm and worm gear *E*, operating a coarse screw *F*, threaded in the bottom of the head.

The work-table *J* is supported on ball bearings on the lifting table *H*, which is moved up and down to feed the cutters into the work and withdraw them. The work spindles *M*, mounted in table *J*, have keyed to them gears *L*, meshing with the gear *K* fast to *H*. As the work-table is indexed to bring the work spindles into successive positions under the three cutter spindles, the work is indexed by gears *K* and *L* to the proper positions for cutting hexagonal sides, bringing a new pair of work faces to each set of cutters. The index ring *O* is locked by a bolt, controlled by a handle within con-

venient reach of the operator. The work spindle has an interior sliding spindle into which the work plug is secured. This interior spindle is threaded to a screw attached to hand-wheel *N*, and is raised and lowered by the turning of the latter. The hand-wheel thus serves to clamp the work, and its action brings it down against a solid shoulder, holding it securely in place during the operation.

Table *H*, and with it the work spindle and the work, is raised and lowered by a yoke *P*, the motion being guided by pins *Q*, which pass through lugs on the side of the column. The operation of the yoke is controlled by the cam and link movement, seen best in Fig. 1. The cam is operated by gearing from the drive shaft as shown. The feed may be thrown out at any time by a positive jaw clutch.

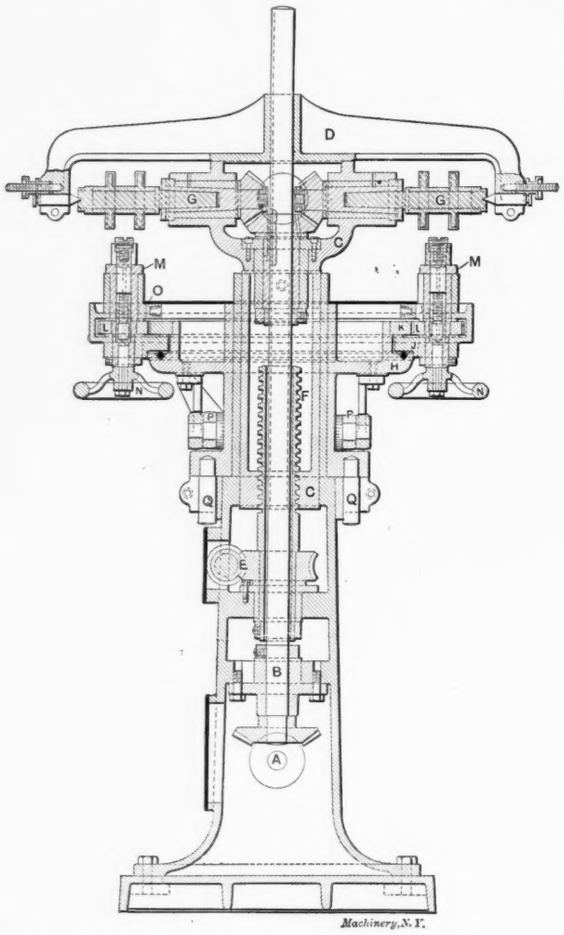


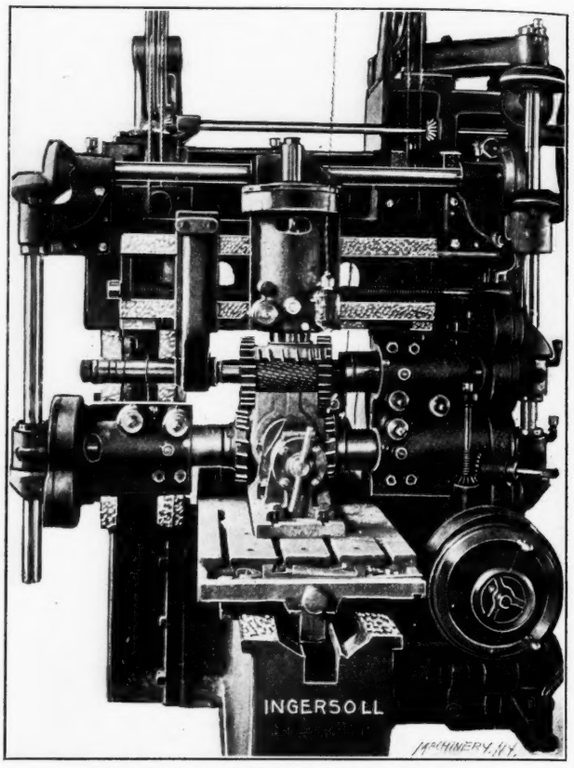
Fig. 2. Vertical Section, showing the Mechanism.

The weight of this machine is about 1,500 pounds. It is strong and substantial in construction, and has sufficient driving power for finishing nuts up to 3 inches across the flat. An output of 240 ¾-inch nuts per hour, or their equivalent in other sizes, represents the working capacity of the machine.

INGERSOLL SPECIAL FOUR-HEAD MILLING MACHINE.

The four-spindle milling machine shown herewith, illustrates the extent to which it is possible to specialize a machine of this kind by a slightly different arrangement of the spindles, without incapacitating it in any way for regular work. This machine, built by the Ingersoll Milling Machine Co., Rockford, Ill., carries two horizontal spindle heads on the right-hand upright, and one on the left-hand. There is a fourth head mounted on the cross rail; the cross rail also carries an outward support for an arbor, which may be driven by the upper of the two spindle heads on the right. When the machine is so used, this spindle head is fastened to the cross rail and is adjusted up and down with it, making the machine, to that extent, a slab miller.

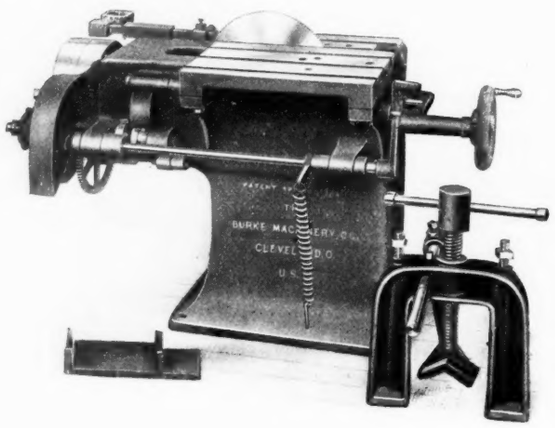
The engraving shows the tool operating on the work for which it is specially designed. The two lower horizontal heads each carry face mills. The upper horizontal head carries an arbor, which is clutched to the face of the spindle and drives a gang of cutters. The vertical head carries a face mill. This vertical head is far enough in advance of the horizontal arbor so that it is used for roughing out the cut, which is immediately finished by the cylindrical cutters on the arbor. It will be noticed that each spindle has a longitudinal adjustment.



Ingersoll Four-head Milling Machine in Operation.

IMPROVED BURKE COLD SAW.

The Burke Machinery Co., 1837 35th St., Cleveland, Ohio, has re-designed the cold-sawing machine, which we described in the June, 1908 issue of MACHINERY. Among the changes is the provision of a screw-feed, with ball-bearing thrust, in place of the rack and pinion feed previously used. This has meant an entire re-arrangement of the feed mechanism.



Improved Design of Burke Cold Saw.

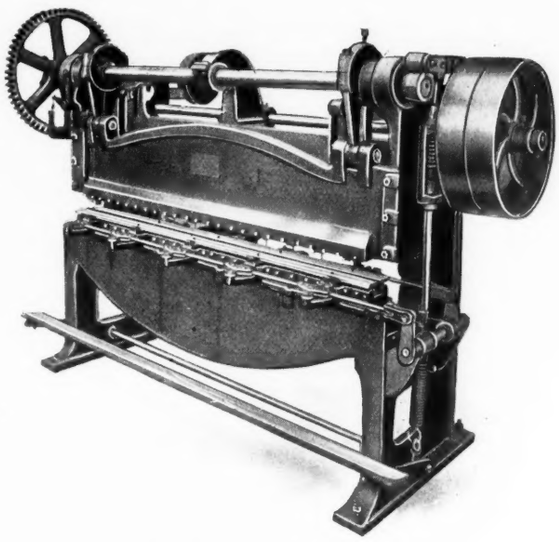
The saw blade rests upon and is bolted directly to a bronze worm-wheel. It is driven from it by three ½ inch cap screws and three ½ inch pins of hardened drill rod. These driving holes are well out from the center of the blade and give an unusually strong drive. This worm-wheel with the attached saw is mounted in a carriage sliding in suitable ways across the bed of the machine. At the front of the carriage is bolted a hardened steel casting, which acts at the same time as a guide to the saw and as a stripper

for carrying away the chips from the teeth. An automatic throw-out is provided for the feed. In the train of feed gears is a loose gear, confined between two flanges lined with leather. A spring and adjusting collar tighten these flanges to the gear, and furnish the friction slip, which will give under abnormal pressure.

The machine shown is provided with tight and loose pulleys. A three-step cone with a suitable counter-shaft will be furnished in place of this, if desired. The clamps for holding round and irregular shaped stock are seen on the floor at the base of the machine. A stop for cutting to length is provided, as shown. This machine is made in two sizes, for 12 inch, and 20 inch saw blades. These have respectively a capacity for round stock up to 3 inches, and 5½ inches in diameter. The extreme capacity for rectangular stock is for each case, 3 x 5 inches, and 5½ x 12 inches. The capacity for ½ inch flat stock is 9 inches and 20 inches wide, respectively. The net weights are 500 and 800 pounds. The machines sell at the remarkably low prices of $80 for the 12-inch machine, and $160 for the 20-inch machine.

BERTSCH GANG PUNCH.

Bertsch & Co., of Cambridge City, Ind., make the multiple gang punch shown herewith. The ram and die bed are provided with a multiplicity of punches and dies, which may be set either by universal or independent adjustment to the center distances required to suit the work in hand. The machine illustrated has an auto-



A Gang Punch with Adjustable Dies.

matic clamping mechanism for holding narrow bars or strips. Each machine is provided with a stripper properly designed for the particular work for which it is to be used. The machine may be furnished with the automatic clutch used on the makers' regular shears. This clutch is noiseless, positive and reliable in its action. The castings and steel parts for each machine are carefully calculated for the stresses imposed on them, particular care being given to have the bearings and gears of the right proportions. The machine is furnished by the maker in a variety of sizes for a wide range of work.

NO. ½ VAN NORMAN DUPLEX MILLING MACHINE.

In Figs. 1 and 2 is shown a new design of the Van Norman duplex milling machine built by the Waltham Watch Tool Co., Springfield, Mass. The special feature of this machine, as in all of the Van Norman millers, is a movable cutter head mounted on a ram which can be adjusted in or out over the table, permitting the advantageous use of cutters for either vertical, horizontal or angular work. This particular machine meets the requirements for tool-room work, or general purpose light manufacturing.

The slides are operated by means of conveniently placed hand-wheels. That at the right of the knee in Fig. 2 is used as a quick return for the table. The table feed is operated by a revolving nut, the table screw being locked by a pawl which is thrown out of engagement when this feed is operated by hand. A table stop is provided, and means are furnished for clamping the table solidly when the longitudinal feed is not being used.

The cutter spindle holds a large split collet; large mills are mounted on a collet plug. The spindle is hardened and ground

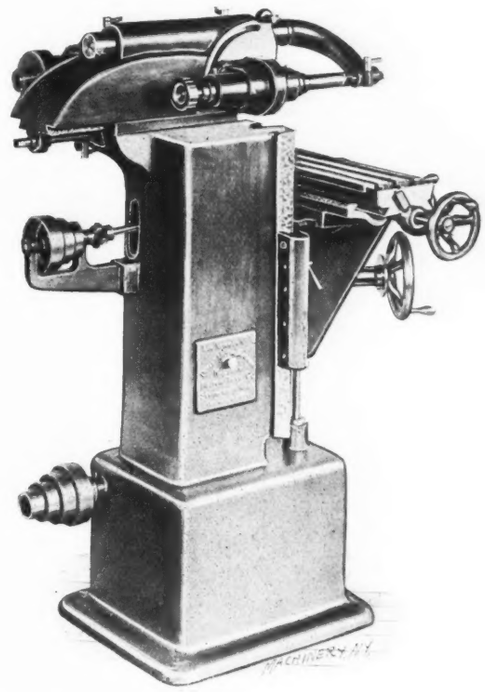


Fig. 1. Van Norman Miller, arranged with Spindle Horizontal.

and runs in hard bronze boxes. The taper bearings are set up by an adjusting nut at the rear of the spindle. The driving cone is mounted on bearings at the side of the column. The splined driving shaft is connected to the cutter spindle by double bevel

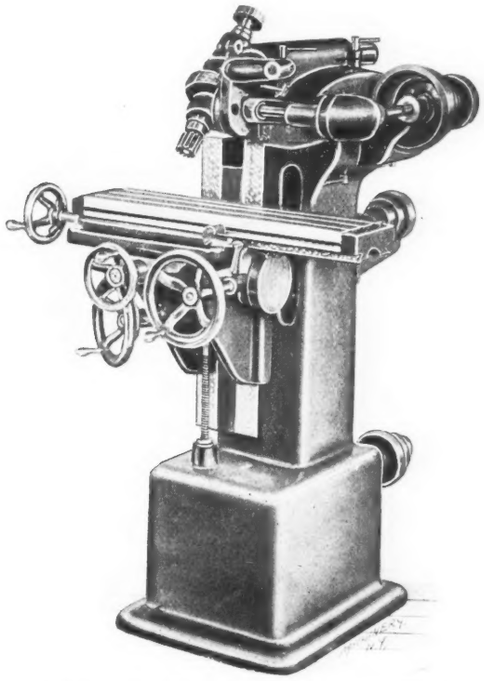


Fig. 2. Cutter Spindle Swiveled for Angular Milling.

gearing. Fig. 1 shows the machine as arranged for horizontal milling, using the over head arm. Fig. 2 shows the ram adjusted forward, with the cutter spindle fixed at an angle. This machine weighs about 1,200 pounds. A semi-universal index head with draw-in collet is furnished if desired.

DALLETT AIR COMPRESSORS.

We illustrate in Fig. 1 a new belt driven air compressor which is one of a line built by the Thomas H. Dallett Co., 23d and York Sts., Philadelphia, Pa. This line has been designed to meet the most exacting requirements for a machine of this kind. The general ruggedness of the design is plainly shown in the engraving. The following description will give some idea of the way in which the details have been worked out.

The base is of the Tangye type; the main bearings have nearly three times the area called for by conservative calculations, and so may be depended on to run without heating and with a high overload as well, permitting the use of a larger capacity cylinder for the regular 100 pounds pressure, if desired. A flanged end is provided for bolting the cylinder to the frame; the convenience of this construction when tightening the nuts on the cylinder studs, will be appreciated by the engineer. The cylinders are of a special hard close-grained iron, cast with walls thick enough to allow for reboring when necessary.

A drain cock is provided at the lowest point on the cylinder heads, for use in cold weather. The clearance space is reduced to a minimum, and this, with the large water jacket cooling surface provided, results in a high efficiency. The lubricant is fed into the outlet passage, from which it is carried through the cylinder in the form of a fine spray. The connecting rod and crank shaft are of the marine type; both crank pin and cross head pin boxes are of high grade phosphor bronze. The crank shaft is forged from a solid billet of mild open-hearth steel.

The air inlet and discharge valves are shown in Figs. 2 and 3

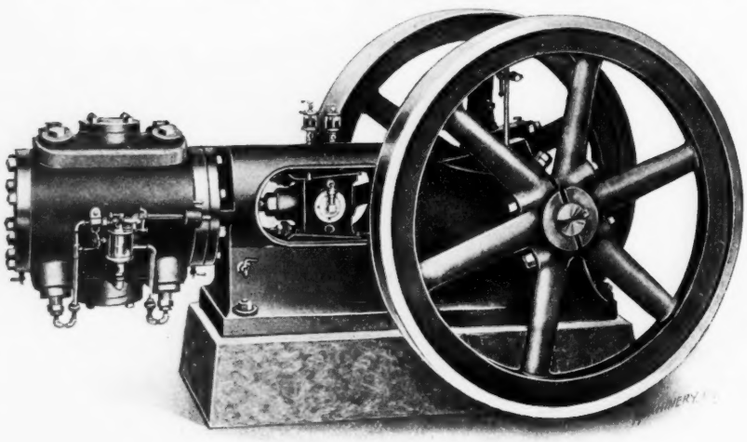


Fig. 1. A Belt-driven Example from a New Line of Dallett Air Compressors.

respectively. The outlet valve is a complete unit in itself, with no guides or stops to screw into the cylinder. The valve cap acts as a lock, holding the cage tight after it has been screwed down into its seat. Corrugated copper gaskets are used for forming the joints of the valve cage and cylinder, and under the valve cage cap. The valve is light, and of the proper area. The valve proper is of high-grade hardened steel with the seat and all wearing surfaces accurately

Fig. 2. The Self-contained Inlet Valve used on Dallett Air Compressors.

ground. The tension of the phosphor bronze valve spring is carefully determined to give a light action, and yet shut the valve promptly on closing. The spring holder is of unique construction, consisting of a split taper ring set into a recess in the valve spring, and held there by a solid taper ring which slides down over it. This entirely eliminates trouble from the shearing off of the spring holder, as sometimes occurs when held by a jamb nut or taper pin. The discharge valve, shown in Fig. 3, is of extremely simple design, being self-contained and having but four parts; viz: the malleable iron cage, the valve proper, the valve spring, and the cap. The latter acts as a positive stop when the valve has reached its full

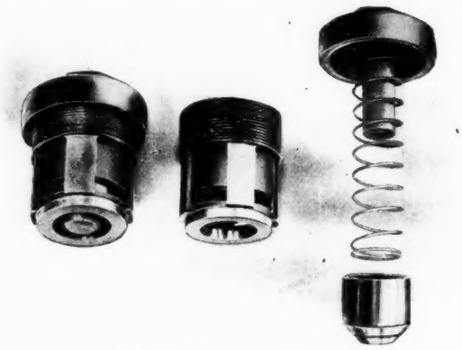


Fig. 3. Dallett Discharge Valve.

opening, thus obviating fluttering. Both valves are of large area and are practically noiseless in their operation. The time required to remove one from the cylinder is less than a minute.

Pressure regulation is provided for in these belt driven machines, by an unloading device which automatically opens the air cylinder to atmospheric pressure when the receiver pressure has reached a certain pre-determined amount. This device holds open one or more outlet valves at both ends of the air cylinder, taking the load off the compressor, and allowing it to run light until the pressure drops in the receiver, when the valves are released and the air compression is resumed.

The makers also build a similar line of steam driven air compressors of the straight line type, either single, duplex or compound. In these a combined speed and pressure governor is used. The governor unloads the air cylinder exactly the same as on a belt-driven machine. At the same time, it controls the speed, allowing a single steam machine to just turn over when unloaded, and bringing a duplex or a compound machine to a dead stop. By this means a great saving in steam is effected, as well as a reduction in the wear and tear on working parts.

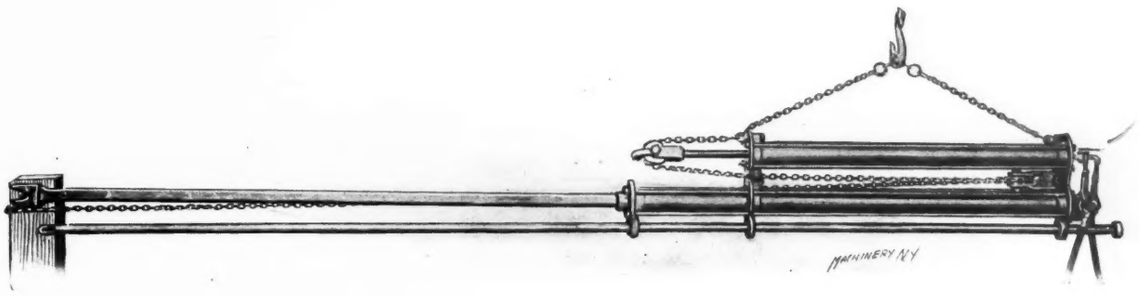
WILLIAMS, WHITE & CO.'S STAY-BOLT BREAKER.

Mr. Grover S. Lowe, a machinist in the Rock Island shops at Silvis, Ill., has invented a machine for breaking boiler staybolts, which works with rapidity and safety, so that jobs which formerly required five men's work for five days, are now done by two men in fourteen hours. It is not only useful in breaking staybolts when removing fireboxes from boilers, but can be used as well in wrecking steel buildings and bridges.

This machine, of which a general view is shown herewith, may be described as follows: It consists primarily of two parallel cylinders securely fastened together. A valve is attached to the back end of each. The only purpose of the valve in the shorter cylinder is to act as a cut-off or a back pressure valve. The valve at the back of the longer cylinder is quadruple acting. The 100 pound striker or sledge is fitted in this cylinder. The front end is a cutting bar, with a boss welded around it at its rear end. Two lines of hose carrying compressed air are attached to the machine. One of them supplies pressure to the short cylinder, in which is fitted a piston which, by means of a chain and sheave, is made to hold the machine firmly against the cutting bar, pressing this in turn against the bolt to be cut. The machine thus moves forward automatically, taking up the slack as the bolts are broken.

The other hose is attached to the quadruple valve on the iron cylinder for operating the striker. Moving the handle of this valve in one direction admits compressed air behind the striker, sending it forward with great force, which is transmitted to the bolt to be broken. Twenty-eight 15/16-inch bolts have been broken by this means in three minutes. The machine is suspended from a crane or tripod, so as to be easily handled.

Three times the work with about ⅓ the men is the estimate as to the efficiency of the apparatus, and in the matter of safety there is no comparison. With the old methods the work of breaking staybolts is more dreaded than any other the boiler-maker is called upon to do. One of these machines is kept in constant service in the shop where it was designed, and it has displaced five other tools for the same purpose. The builders are Williams, White & Co., Moline, Ill.

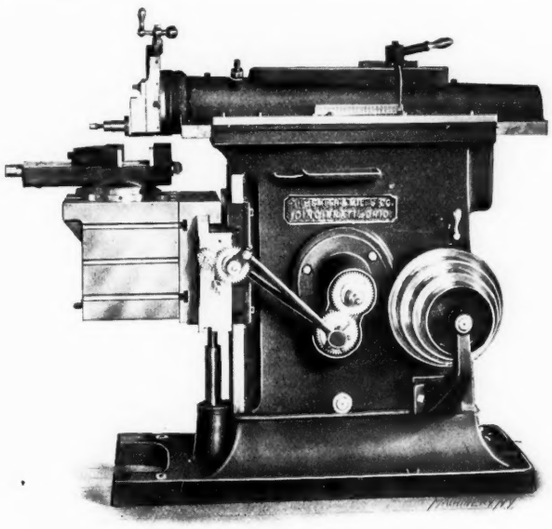


A Pneumatic Staybolt Breaker Invented by a Machinist in a Railroad Shop.

SMITH & MILLS HIGH-SPEED BACK-GEARED CRANK SHAPER.

The crank shaper made by Smith & Mills, of Cincinnati, Ohio, has been redesigned to keep pace with the increasing demands of modern service. Entirely new and heavier patterns have been used throughout. The resulting machine is shown in the accompanying engraving.

The column is of generous proportions, strongly braced and ribbed on the inside, and with projections front and back for the ram guides. The base is provided with pads for attaching a table support if required. An outside bracket supports the end of the driving shaft. The box table furnished with the machine is arranged for clamping work on either side, or at the top; it can be removed if required, allowing work to be bolted to the slotted apron. The telescopic elevating screw for the cross-rail is fitted with ball bearings. It is unnecessary to make an opening in the floor for this screw.



Smith & Mills High-duty Shaper.

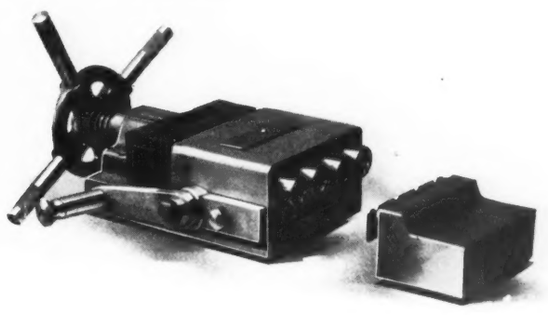
Among the new features of the machine, should be mentioned the fact that the changes of stroke, feed, speed and position of the ram are all made from the working side. The change in the length of stroke is made without stopping the machine. A locking device is provided which clamps the crank-pin rigidly, so that there is no possibility of a variation in the length of the stroke while the machine is in operation. The crank lever is adjustable to the wear of the sliding block, and is connected to the ram by a link. The automatic cross-feed of the table can be instantly changed while the machine is in operation. A new device on this machine is the automatic vertical feed for the cross-rail, which provides for raising the rail, table and work vertically, and feeding it against the tool. Micrometer dials are provided for the various movements, adapting the machine particularly to the cutting of racks, or, in conjunction with index centers, to the planing of gear teeth. A table of dimensions for rack cutting is furnished.

There are eight changes of speed on each machine. The back gears provide for this with the four-step cone. On a 16-inch machine these speeds range in geometrical progression between 6.21 and 157.15 strokes per minute. On the 20-inch machine the range is from 7 to 100.8, and on the 25-inch machine from 6.75 to 80 strokes per minute. The equipment of each machine includes a counter-shaft and the necessary wrenches, together with a swiveled jaw vise with a graduated base and steel-faced jaws. In ordinary work the 25-inch machine has removed a chip 1 inch deep, 3/16 inch thick and 18 inches stroke, at the rate of 15¼ cubic inches of steel per minute.

MILLER & CROWNINGSHIELD MULTIPLE SPINDLE INDEX CENTERS.

The multiple spindle index centers shown herewith are made by the Miller & Crowningshield Co., of Greenfield, Mass. The device is intended to be used in such work as fluting taps. The construction employed permits blanks of different lengths to be simultaneously and uniformly clamped in the four spindles by a single movement of the clamping wheel. An improved indexing device is also provided.

The tail-stock is practically a solid piece, as shown. The work is clamped by the end movement of the head-stock spindles. This end movement is effected by the screw and pilot wheel shown, which acts through a system of equalizing levers. The levers distribute the pressure over the four spindles, whether or not the four pieces of work are of equal length, within reasonable limits. It is possible with this arrangement to hold one or any number of pieces, up to four at a time, with equal firmness. The spindles are indexed by spur gears mounted on them, meshing with spiral gears on the index crank shaft, which passes through the head at a slight angle. This shaft is mounted in an eccentric bushing, which provides for adjustment in the case of wear. The ratio of the gearing is such that one complete turn of the index crank turns all the spindles in the same direction, into position for a new cut.

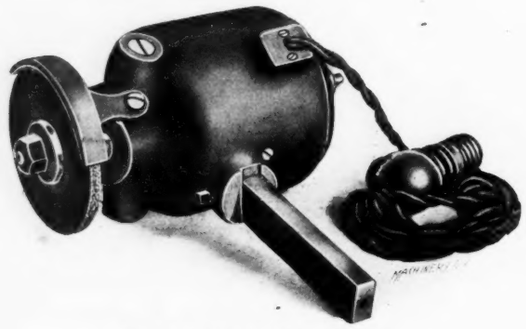


Multiple Centers for Fluting Taps, etc., provided with a Balanced Clamping Arrangement.

WILLEY PORTABLE ELECTRIC GRINDER.

This grinder, made by the Willey Machine Co., Jeffersonville, Ind., is adapted to general grinding in the lathe. It can be used for plain cylindrical grinding in any lathe, or for taper grinding

in those provided with taper attachment or compound rest. The device is held by its shank in the tool post, the same as a lathe tool, and is operated by a lamp cord and socket connection with a shop-lighting circuit. It is particularly useful for center grinding. On lathes having plain rests only, the centers may be ground by



Electric Lathe Grinding Attachment.

taking a succession of cuts the width of the wheel, finishing the centers to gage. The brushes and all the connections are enclosed and the bearings are adjustable for wear. The wheel is provided with a strong guard.

"OMNI-PRESENT" LIGHT-HOLDER.

The Pennsylvania Specialty Mfg. Co., Cochranton, Pa., is making the "Omni-Present" light-holder, which is shown in detail in Fig. 1, and applied to a lathe in Fig. 2. This light-holder permits a lamp to be placed in any conceivable position, to which it may be instantly adjusted. It is especially useful in such work as internal threading and measuring. It may be used for the desk, drafting-room, table, machine, vise, etc.

This holder consists of a standard to which is attached a double flexible arm, connected by universal joints. An insulated swivel

Fig. 1. "Omni-Present" Light-Holder made by the Pennsylvania Specialty Mfg. Co.

joint is provided for holding the lamp to the outer end of the arm. Two forms of base are provided. One of them seen just under the standard in Fig. 1 may be screwed to a table or machine. The other form, shown at the left, is used for mounting the holder in the T-slots of the milling machine, lathe, or other tool. The base of the holder may easily be changed from one end of the table to the other, or from one machine to another. These holders will be furnished with longer arms than shown at a slight additional

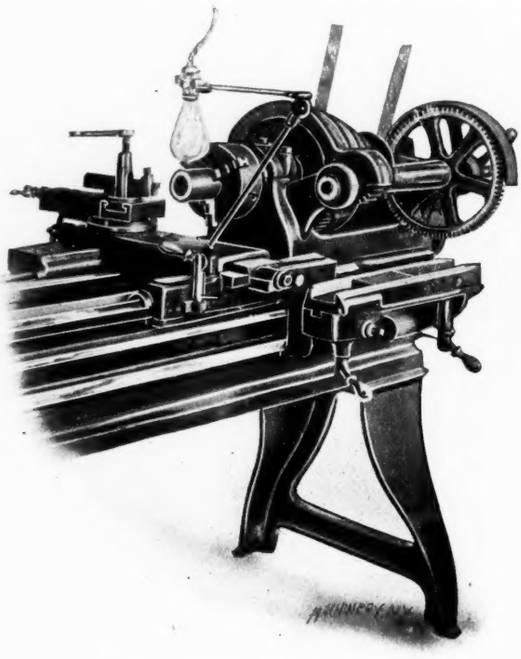
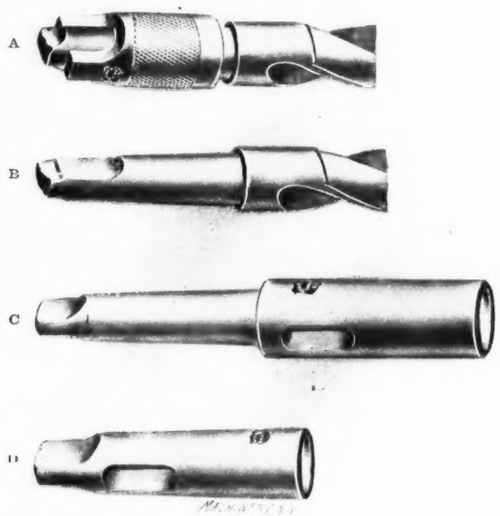


Fig. 2. Application of the Light-Holder.

cost. The finish of the parts is in oxidized copper, the base is japanned, giving the appliance an attractive appearance.

STANDARD TOOL CO.'S "ECONOMY" DRILL SOCKETS AND SLEEVES.

The Standard Tool Co., of Cleveland, Ohio, has recently placed on the market a shortened design of the regular taper socket and sleeve. This design is used for extending the life of twist drills which have failed, from the twisting or breaking of their driving



Short Sockets and Sleeves, for using up Drills with Broken Shanks.

tangs. Such a drill is shown at *B* in the engraving. This drill has had a new tang formed on it, it will be noticed, by milling flats further up on the taper. By the use of the gage shown at *A*, lines may be scribed, to which the flats are formed on the broken shanks; this may be done by grinding, filing or milling, as most convenient. When the broken tang is thus treated, it may be used in the socket as at *C*, or the sleeve as at *D*. The new tang is heavier and stronger than the old one, and insures an accurate and powerful drive. The shanks of the "Economy" sockets and sleeves are made of regular dimensions, and will fit the regulation Morse taper

hole in the drill press spindle. The use of this appliance should save many otherwise useful drills from being consigned to the scrap pile.

WALKER TOOL-ROOM GRINDER.

The tool-room grinder made by the Walker Grinder Co., Worcester, Mass., is now made in a new design, which is herewith illustrated and described. This new design includes, among other improvements, a new table feed mechanism, and an improved construction of the spindle head, which allows a greater range of adjustment to the spindle without interfering with the free running of the belts.

The characteristic feature of the Walker grinder is the provision made for swiveling the cutter spindle in two planes, about a vertical and a horizontal axis. This provision allows the utmost flexibility in setting up work of a difficult character, and renders unnecessary

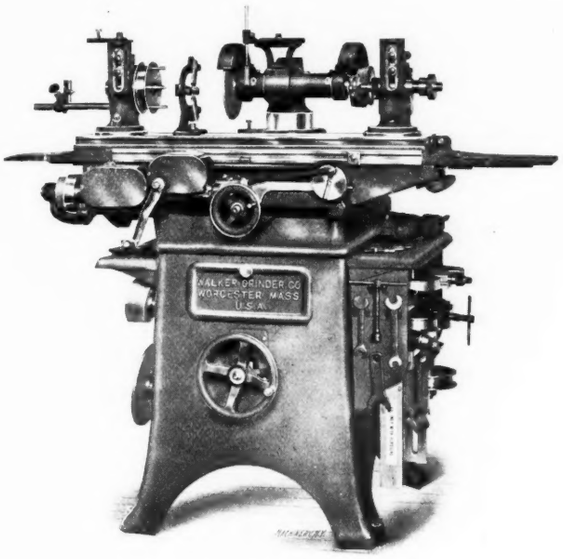


Fig. 1. The Walker No. 2 1-2 Tool-room Grinder.

the use of complicated and insecure holding devices for such work as grinding face mills, spiral reamers, etc. The arrangement of this well-known drive is shown diagrammatically in Fig. 2. The belt on the counter-shaft pulley A, passes down to an idler B at the head of the spindle column. From here it passes over the spindle pulley C, back to a second idler D in the column, and down through to the lower idler E in the base of the machine. The adjustment for height is effected by raising or lowering the spindle column F. The adjustment of the spindle is about axis xx in one plane and yy in the other. The adjustment about axis xx carries idler E with it, twisting the belt without materially altering its length. Similarly, the swiveling about axis yy is permitted without material change in belt length. The two movements may be made simultaneously, or together, with perfect freedom.

The improvement at this point in the new design consists in mounting idler B (which is flanged, and of about the width of the belt) on pivot G, so that it swings in a vertical axis zz as shown;

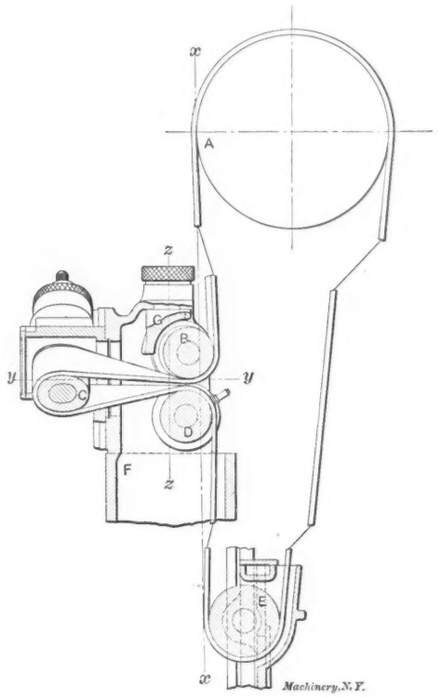


Fig. 2. The Improved Belt Drive of the Walker Grinder.

and in lengthening idler D to permit the belt to travel from one side to the other as required. This permits extreme adjustment without harmful straining of the belts, or rubbing against flanges of the pulleys.

The new cross and longitudinal feed mechanism is shown in the line engraving, Fig. 3. It is driven from the main counter-shaft through a jack-shaft mounted at the side of the machine, which carries a two-step cone pulley connected with that shown at H. This, through the bevel gear and the clutch reversing mechanism J, drives the drum K. This drum, in turn, through the gearing indicated, operates the rack pinion shaft L, by means of which the table is reciprocated. A disengaging clutch is provided for throwing out the feed independent of the reversing mechanism by the longitudinal movement of pin M. The reversing is controlled by dogs N and N', adjustable in the T-slot at the front of the table. These shift slide O to the right and left alternately. Projection P and P' on slide O alternately compress springs Q and Q', which press against boss R, attached to the reversing clutch rod. As dog N pushes slide O to the left, for instance, spring Q is compressed;

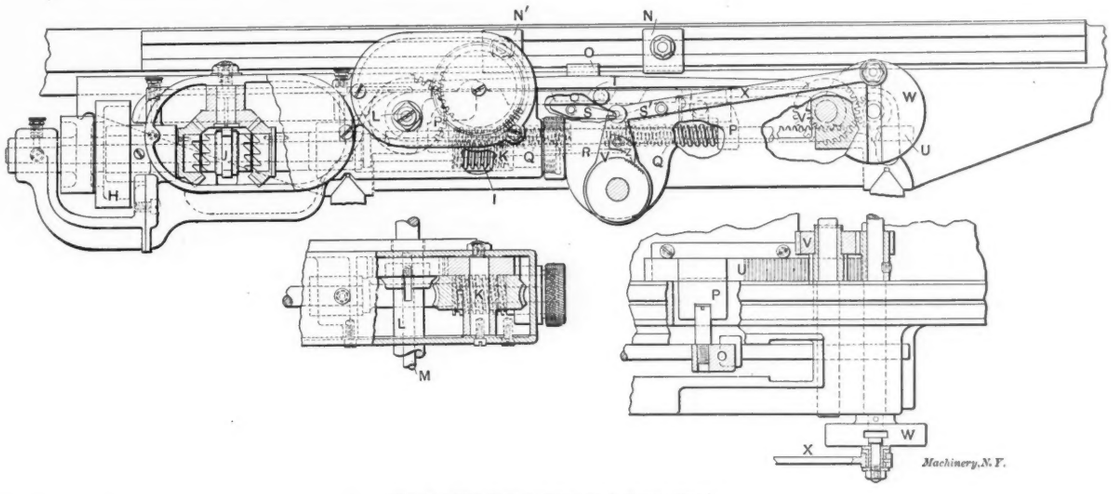


Fig. 3. The Table Drive and Cross Feed.

but R is prevented from operating the clutch rod under the pressure of the spring, by latch S. This latch is finally released by a cam T on slide O, which allows the spring to suddenly reverse the clutch. For reversing at the right of the stroke, dog N' moves slide O to the right, causing projection P' to compress spring Q'. When it has been compressed sufficiently, T raises latch S' allowing the clutch rod to be thrown over in the other direction, again reversing the mechanism. This arrangement, which is similar to others used for the same purpose, avoids the possibility of stopping on the center.

The automatic cross feed is operated by slide U, which is connected so as to reciprocate with slide O under the influence of dogs N and N'. U has rack teeth cut on its upper surface, engaging with the compound idler gear V. This, in turn, imparts at each reversal a half revolution to slotted crank disk W. The crank-pin adjustably mounted on this disk operates connecting rod X, which thus gives a back and forth angular movement to a bell crank which, in turn, by means of pawl Z, gives a ratchet feed to the cross-feed screw at each reversal of the stroke. The amount of the feed is regulated by the position of the crank-pin in the slot on the face of crank W. For reversing the feed, a similar ratchet to the one shown is mounted behind the bell-crank; it, however, has teeth pointed in the opposite direction. When one pawl is thrown in, the other is out, and *vice versa*.

In this new design, the best features of the previous machines have been retained. The overhead works is of the multiple speed type, with no step-down of the revolutions per minute, and providing for a wide range of adjustments between the maximum and minimum. The machine is furnished, as shown, completely equipped for cutter grinding, or for cylindrical and surface grinding, thus making it especially useful for tool-room work.

DIRECT BELTED GRINDER WITH SELF-OILING LOOSE PULLEY.

The Artisans Guild, Benton Harbor, Mich., is building the direct drive grinder shown herewith. The spindle of this grinder is provided with tight and loose pulleys, so as to make a countershaft unnecessary. As may be seen, the column is of rigid construction with long bearings and a heavy spindle, adapting the machine to the severe service that is likely to be required of it.

The principal novelty in the construction of this machine is the loose pulley. This pulley is self-oiling, and has a reservoir for lubrication, which requires refilling not oftener than five or six

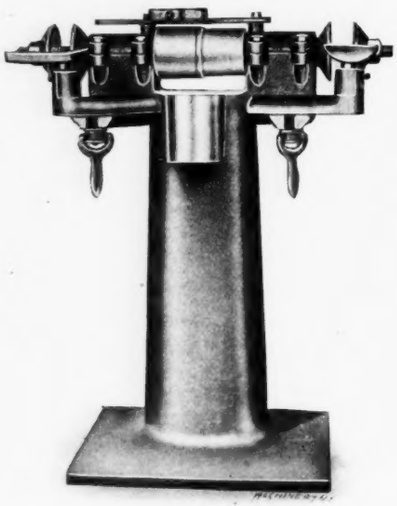


Fig. 1 Grinding Stand made by the Artisans Guild.

times a year. Its construction will be understood from Fig. 2, which shows a sectional view through the hub and oil reservoir. This journal, it will be seen, is ring-oiled, but on a different principle from the usual form, since the bushing is the revolving part, while the shaft remains stationary. The ring is of such diameter as to ride on the bottom of the revolving oil chamber, and almost touch the top of the stationary shaft. As the pulley revolves, it thus rotates the ring, which carries the oil up to the top of the shaft, from which it finds its way into the bearings on either side. After working its way through the bearings to the outer ends of the hubs of the pulleys, it is collected in an annular groove, and returned by centrifugal force through the ducts shown back to the central reservoir again.

This oiling arrangement may also be furnished in the form of a self-oiling bushing, to be applied to loose pulleys already in use.

Fig. 2. Ring-oiling Loose Pulley used on the Spindle of the Grinder.

In either form, one of its chief merits is its inexpensiveness as compared with other devices designed for the same purpose. The parts are few and easily made, and the device is automatic in its action, only requiring filling the oil-well at intervals of two months or thereabouts.

CUTLER-HAMMER HAND LIFTING MAGNET.

A novel electrical appliance has just been placed on the market by the Cutler-Hammer Clutch Co., of Milwaukee, Wis., whose large lifting magnets are widely used in the iron and steel industries for handling pig iron, scrap, etc. The new device is a hand magnet weighing only about 7 pounds, but capable of lifting castings of from ten to fifteen times its own weight. The magnet is designed for operation on 110 volt, direct current circuits, and is furnished with a drop cord and attachment plug, so that it may be readily

Fig. 1. A Hand Lifting Magnet.

Fig. 2. Handling Long Nails.

connected to any ordinary lamp socket. The push-button, mounted on top of the magnet and operated by the thumb, closes the circuit to the coils and makes the magnet operative. On releasing the button the poles become demagnetized and the load is released.

The first of these little magnets was built for use in the manufacturer's own shop, where it proved so useful and attracted so much attention from visitors that it was decided to manufacture it in quantities for the market. It seems to be capable of many useful applications. In machine shops it is used for clearing chips and borings out of the machinery, or removing them from parts of the work not easily accessible—as for instance from the bottom of a deep cylindrical casting. Dropped tools, bolts, boring bars, etc., are easily recovered with the aid of the magnet from places from which it would be difficult to fish them by ordinary means.

In shops where large quantities of brass and iron filings accumulate, which it is desirable to separate before selling as waste

material, the magnet is especially useful, since brass is not attracted by the magnet, like iron, thus enabling the two metals to be separated by merely passing the magnet through the mixed metals. In the same manner tacks or nails can be separated instantly from brass screws with which they may have become accidentally mixed. In foundries this magnet may be used to pick up hot or awkwardly shaped castings; smooth plates, which are sometimes difficult to secure a hold on when laying on a flat surface; or for cleansing the molding sand of minute particles of metal.

Suspended with its two poles immersed in the liquid, the magnet will attract to itself any particles of iron or steel which it may be desired to remove from the tubs in which paints, glazes, chemicals, etc., are mixed. One purchaser, who uses several automobile trucks in his business, has put this magnet to a novel use. He is paving an alley in the rear of his store with ashes, and finding that many nails from packing boxes, burned under the boilers, were mixed with the ashes, he is now guarding against punctured tires by employing a magnet to remove the nails from the ashes before strewing them in the alley. In the shipping departments of large establishments many hundreds of nails are recovered daily by hand from the sweeping. For work of this sort, or for handling nails, nuts, screws, etc., in hardware stores, this little magnet should prove useful.

HIGH-DUTY SIX-FOOT SURFACING GRINDER.

In the manufacture of its regular product, the O. K. Tool Holder Co., of Shelton, Conn., has to do a quantity of surfacing on metal parts of various kinds, much of the work being hardened steel. Various methods of doing this surfacing were tried, among others, finishing the parts on the commercial disk grinder. This was not altogether satisfactory in this particular instance, as the emery disks were quickly rubbed smooth, and much time and expense was involved in keeping the wheels supplied with new surfaces. The final solution of the problem of doing this work is shown in concrete form in Figs. 1 to 3, which illustrate a large steel wheel with narrow segmental faces of abrasive. This wheel has proved so efficient from the standpoints of output and cost of upkeep, that its maker has decided to place it on the market.

The disk is of solid steel, and runs on Timken roller bearings, which are carefully protected from grit, and can be renewed at a slight expense. The driving pulley is 36 inches in diameter for a 6-inch belt; it should drive the wheel at about 250 revolutions per minute. The spindle is mounted on rigid frames and base. Four swinging work tables, similar to those used on the regular disk grinder are provided, so that four men can work simultaneously, as in Figs. 1 and 3. These work tables are pivoted at the base of the machine.

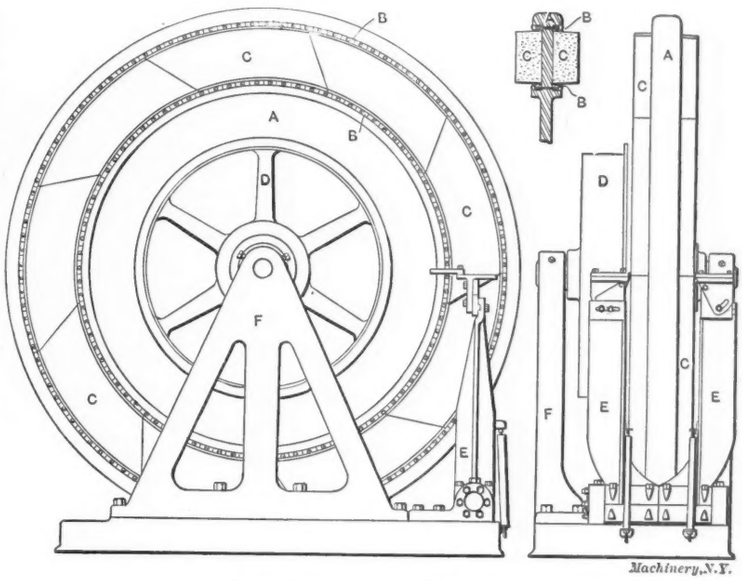


Fig. 2. Construction of the Grinder.

On each face of the rim of the disk is machined a wide, shallow groove, in which segments of abrasive material are set. There are nine segments on each face, each 8 inches wide and 4 inches thick. Before mounting in place, the backs of the segments are carefully surfaced, so that there is no danger of cracking them when they are being clamped into place. They are held by a series of small wedges, which grip the beveled edges of the abrasive, and draw it down firmly into place. To prevent the crumbling of the brittle material when clamping, thin strips of sheet lead are laid between

Fig. 1. A Face Grinding Wheel of Unusual Size.

Fig. 3. Four Men at Work—the Usual Complement of Operators.

the wedges and the segments. To obviate the remote possibility of the work's catching in the joints between the segments, these joints are not made radial, but at a considerable angle, as shown. The method of fastening will be seen to be absolutely safe, as the only possibility of failure is by shearing, and that is highly improbable at any speed which is safe for the solid steel disk.

When the blocks become worn, from 4 inches thick down to 1½ inch, they are packed out by placing wooden strips behind them, after which they may be used down to ½ inch thick, thus wasting but 12½ per cent of the material.

The builders make the interesting statement that they are able to grind on this machine three times as fast as on a wheel of the same grain and grade, running at the same peripheral velocity, but of one third the diameter. Two reasons are advanced for this increase of output. For one thing, the velocity of the abrasive is practically constant throughout the whole width of the 8-inch face, while on the face of the smaller wheel, the speed of the effective face varies from the maximum down to one half or one third of that amount, as the center is approached. This limits the efficiency.

Another point in favor of this 6-foot wheel is its enormous power storage capacity. Momentary pressure, which would slow up a smaller wheel, has not noticeable effect on the speed of this one. All four operators may force their work on the wheel simultaneously, but the stored-up energy carries the wheel around with no perceptible decrease in velocity; in other words the percentage of speed variation is very low.

THREAD MILLING ATTACHMENT FOR "CATARACT" BENCH LATHE.

In Figs. 1 and 2 a thread or worm milling attachment is shown applied to the "Cataract" precision bench lathe, manufactured by Hardinge Bros., 1034–1040 Lincoln Ave., Chicago, Ill. The special mechanism comprises a worm drive for the main spindle

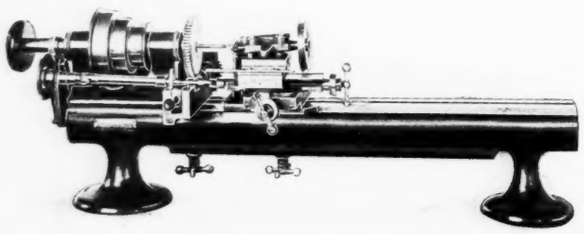


Fig. 1. Thread Milling Attachment used on Precision Lathe built by Hardinge Bros.

and a milling cutter spindle and bracket mounted on the tool-slide. The regular threading attachment is employed. Fig. 1 shows the front side of the machine thus equipped, and Fig. 2 the rear.

To the T-slot in the back of the bed is bolted a support for a supplementary driving-shaft with a cone mounted on it, identical with the regular spindle cone on the machine. This is driven from the same counter-shaft pulley used for driving the main spindle. The driving shaft is connected by bevel gears with a worm, which

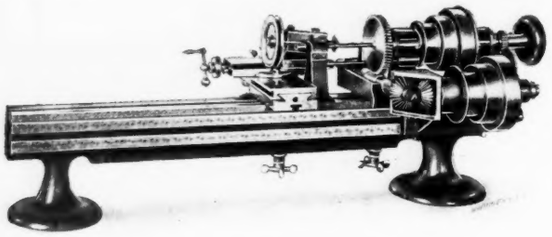


Fig. 2. Spindle Drive for Thread Milling Attachment.

in turn drives a worm-wheel mounted in place of the face-plate on the nose of the spindle. This wheel is connected with the spindle by an arrangement which makes it possible to drive it in either direction without unscrewing from the nose. On the tool-slide is mounted a bracket carrying a cutter spindle. This spindle is held by the block at the required threading angle for the particular job in hand, and is driven from a separate pulley on the front shaft. The regular threading attachment, as mentioned, is used for connecting the main spindle with the tool-rest to give the desired pitch of thread. This attachment is applied to the upper screw of the compound rest, which is set parallel with the axis of the lathe for this purpose. When the required length of thread has been milled, an adjustable stop on the rest strikes a trip which allows the worm to drop out of mesh with the worm-gear on the spindle, thus stopping the machine.

Fig. 1. The Stromberg Chronograph or Electrically-controlled Time Stamp.

This attachment has been found of great service in manufacturing work on such parts as are required for electric meters, anemometers, small taps, etc. The cutter spindle may be used interchangeably with brackets of various angles for threads of various pitches and diameters.

STROMBERG ELECTRIC CHRONOGRAPH.

The use of time stamps in shop accounting and other systems, is not a new idea. So far as we know, however, the Stromberg Electric Mfg. Co., 23 South Jefferson St., Chicago, Ill., is the first one to apply the time stamp to such work without using a clock in the instrument itself. In this new electric "chronograph," as

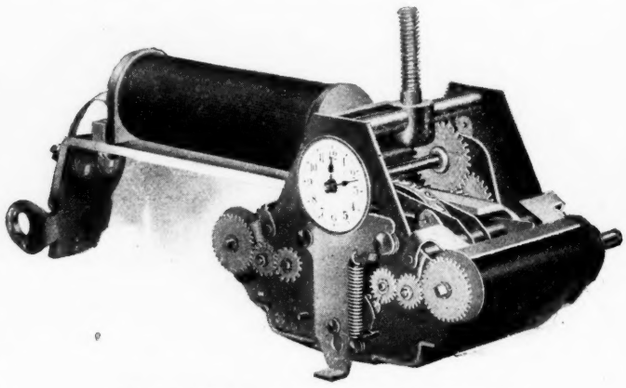


Fig. 2. Interior Mechanism of the Chronograph.

its makers call it, the dies which stamp the time are controlled from a master clock which may be located anywhere in the establishment, and may be used to control synchronously any number of stamps. This insures uniformity of records throughout the establishment; reliability of operation is assured, since there is only one clock to look out for, and that may be of the highest grade; there also results a simplicity in construction of the stamps themselves. It is not necessary to buy a special clock as the proper connections may be applied to any existing time-piece.

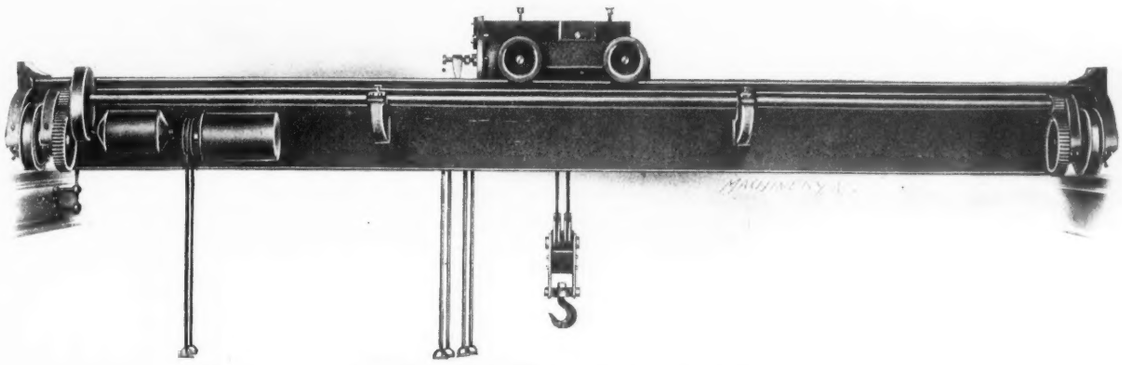
This chronograph is furnished as a plain time stamp for general use, or with such gaging and locating devices or special stamping dies as may be required for special uses. For time card stamping, for instance, gages are provided for locating the records in proper columns and on the proper lines for weekly or monthly records of employes' time. The only change in the device necessary is that of setting the gage from day to day.

This instrument prints right side up. It is provided with an automatic reversing ribbon feed which will give 150,000 impressions without a change of ribbon. The printing wheels and the hands at the side of the dial are moved by a simple magnetic action controlled by an automatic make and break device attached to

the clock. This stamp can stand hard usage without affecting its accuracy, which would not be possible if a delicate clock movement were contained within it. The chronograph mechanism contains no pawls, springs or dogs. It has a positive action and locked printing wheels, which can not be moved except by the interior magnetic mechanism, making it impossible for employes to tamper with it. The instrument requires only a monthly setting.

NORTHERN FLOOR-CONTROLLED ELECTRIC TRAVELING CRANE.

We illustrate herewith a small floor-controlled electric traveling crane built by the Northern Engineering Works, Detroit, Mich. This crane, which can be furnished in either the 1-, 2-, or 3-motor design, is adapted to loads of from 1 to 5 tons, and spans ranging from 12 to 40 feet. As regularly made, it consists of a double-girder bridge upon which rests a trolley, supporting an electric hoist of a type furnished by the makers. Any standard motor will be furnished, however, for either direct or alternating current.



Northern Floor-controlled Electric Traveling Crane.

The trolley is so arranged that it may be operated in either high, medium or low positions, thus adapting it to any height ceiling or any established distance from rail to truss cord. The hoist is equipped with both mechanical and electric brakes, and has an automatic limit stop for the block to prevent overwinding. The mechanical brake not only assists in holding the load but effectually controls the lowering operation as well. The automatic limit stop is operated by positive contact and does not depend on the hoisting ropes for its operation. The hoisting gearing is of the spur geared type, no bevel worm or planetary gearing being included in the crane. It is entirely enclosed in an oil-tight case.

The controllers have ample resistance for giving a wide range of speed, thus making the crane well suited to delicate handling such as is necessary over foundry floors, and in riveting work, etc. While it is regularly furnished to be controlled from the floor by ropes or levers, it can be arranged, if desired, to be controlled either from a cab attached to the bridge, or from a fixed operating stand on the floor.

TEMPERED, POLISHED AND BLUED STRIP STEEL.

The illustration shows a roll of interesting product, for which Edgar T. Ward & Sons, 23-25 Purchase St., Boston, Mass., are the American agents. It is a roll of 2-inch by 0.002-inch tempered, polished and blued strip steel, true to gage, and suitable for making fine springs and other parts of machinery for which a tempered stock is required. Many other uses for thin metal of this order will be found in the manufacture of small machinery. The company carries in stock 180 sizes ranging in thickness from 0.0015 inch to 1/16 inch, and in widths from ⅛ to 6 inches.

The company also sells approximately the same assortment of cold rolled steel not tempered, but of a carbon content capable of taking a high temper. This metal is suitable for formed springs, machine parts, circular cutters, saws, etc. Another grade of thin metal of lower carbon is supplied in rolls which will not harden.

Tempered, Polished and Blued Strip Steel.

SCREW CUTTING ATTACHMENT FOR ELGIN PRECISION LATHE.

The device shown in the accompanying engravings, built by the Elgin Tool Works of Elgin, Ill., for cutting threads with its precision lathe, is of the design which gives the greatest simplicity and directness of construction. It consists of a set of change gears mounted on a sector at the rear end of the bed, and connected with the feed-screw of the compound rest by universal joints and a telescopic shaft. No special lead-screw is required.

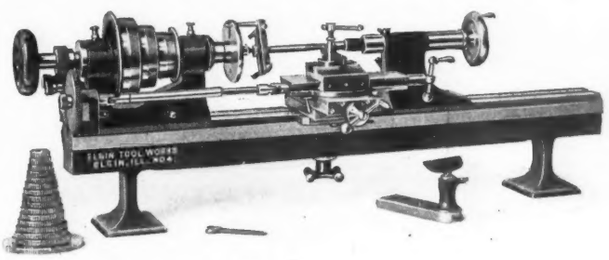


Fig. 1. Screw Cutting Attachment operating on the Feed-screw of the Compound Rest.

The sector is clamped to the lathe bed by a T-bolt. It carries the necessary studs for the change gears, which mesh with a driving pinion mounted directly on the spindle. The change gears provided cut English or metric threads as required. The range of English threads is from 10 to 150 per inch. The upper slide of the compound rest is made of extra length, permitting the cutting of long threads. So long as this lead-screw is set parallel with the ways of the lathe, which it has to be to cut a straight thread,

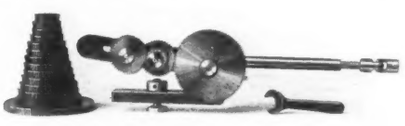


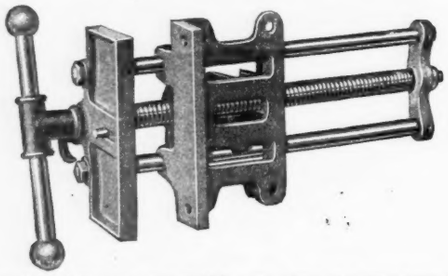
Fig. 2. Elgin Screw-cutting Attachment Dismantled, showing its Simplicity.

the simple universal joint connection provided will give it a rotation uniform with the spindle.

Fig. 2 shows the parts of this attachment disassembled, and illustrates the extreme simplicity of its construction.

YOST QUICK-ACTING MANUAL TRAINING VISE.

The G. M. Yost Mfg. Co., Meadville, Pa., has recently devised the quick acting vise shown in the accompanying illustration. It is particularly adapted to the needs of manual training schools or other wood working plants, where a quick acting vise at a reasonable cost is required. This vise is of the combination type, since it can be used either as a regular screw vise or with the quick acting feature. It is unnecessary to reverse the handle in releasing the quick acting movement. It is very simple in construction, having



A Simple and Inexpensive Quick-acting Vise for Wood-working.

only eight parts in all. The vise is made with either wood or leather face jaws as required. It can be furnished also with a taper attachment to the front jaw, permitting tapered or irregular work to be clamped securely. The rods are of cold drawn steel, and the screw is of high grade tool steel; the jaws are gray iron castings. It is made in eight different sizes, with jaws up to 10 inches long and 4 inches deep.

* * *

NEW MACHINERY AND TOOLS NOTES.

Screw-Driver: Elmore Tool Mfg. Co., Hartford, Conn. This screw-driver is drop-forged in one piece with the handle, which has wooden grips rivetted to it, jack-knife fashion. The shank is square so that a wrench may be used with it if required.

"Gravity" Level for Machine Shop and Tool-Room Use: Risdon Tool Works, Inc., Waterbury, Conn. This level is of the type in which a pointer, moving over a graduated dial, is connected with a hanging weight in such a way that a slight movement of the latter gives a multiplied movement to the pointer.

Light, Rapid Action Punch: Rock River Machine Co., Janesville, Wis. This tool is intended for light steel punching, in plate up to $\frac{3}{8}$-inch in diameter. It may be also fitted for shearing arrangements for bar or round iron and for angles. It will shear angles up to 2 x 2 x $\frac{1}{8}$ inch. The frame and the floor standard are cast in one piece.

Universal Cam Cutting Machine: Kearney & Trecker Co., Milwaukee, Wis. This is an adaptation of the builders' standard milling machine; it is provided with a special table and work feeding and controlling apparatus, which fits it for the cutting of either face or pheriphery cams. Like all machines of its kind, a form or master cam is employed for giving the desired shape to the work.

Power Press With Automatic Feeding Mechanism: V. & O. Press Co., Glendale, L. I. This firm has recently brought out a line of inclinable power presses for automatic production of parts in sheet metal, fiber, etc. A recent equipment includes all the machinery necessary for making an improved four-part, metal bottle cap.

Cold Bend Testing Machine: Messrs. Tinius Olsen & Co., Philadelphia, Pa. This machine is used for the "cold bend" testing of specimens of iron and steel. The machine is provided with an electric motor of such power that specimens up to 1 inch square or its equivalent may be bent cold in about three minutes to an angle of 180 degrees. Bending dies for stock of any size up to 2 inches may be used; the smaller dies are reinforced to withstand the bending pressure.

"Rochester" Helve Hammer: West Tire Setter Co., Rochester, N. Y. This Helve hammer is of the type which employs a wooden beam with the pivot at one end, and the upper die or hammer head at the other. It is reciprocated by a crank and connecting-rod, attached to the beam by a flexible spring connection. A handle within convenient reach of the operator makes provision for altering the length of stroke.

The Woggle Punching Table: Standard Bridge Tool Co., Pittsburg, Pa. The punching table combines a swinging support for holding the work and presenting any portion of it to the punch, with a combined indicator and stripper, which serves to locate the work with reference to a paper or sheet metal templet.

Set of Tool Makers Scrapers: J. E. Poorman, 1722 St. Paul St., Philadelphia, Pa. This set of three scrapers for tool makers use is provided with handles of knurled steel tubing, and has blades of high grade steel, tempered, ground and polished. Three shapes are provided. One is triangular, hollow ground on all sides; one is rounded and curved, and the third one flat, for plain surface scraping.

Rapid Action Automatic Vise: Quick Automatic Vise Co., 236 Mill St., Rochester, N. Y. In this quick acting vise the jaws are adjusted in the usual way to suit the work. The first piece being clamped in this way, the vise may then be opened and closed for succeeding pieces of the same size by the action of the operator's foot on a pedal. On lifting the foot from the pedal the jaws close as firmly as before. It should prove an efficient tool in manufacturing bench work.

Improved Friction Clutch: Messrs. A. L. Schultz & Son, Chicago, Ill. This clutch is made in sizes from 6 inches up to 72 inches in diameter, transmitting from 3 to 500 H. P. at 100 revolutions per minute. It may be used as a clutch coupling to connect two shafts of the same or different diameters, or it may be attached to pulleys, gears, etc. It operates by the clamping of an internal flange on the driving member between two radial wood-faced surfaces on the driven member. The pressure is applied by a toggle mechanism.

Bench Legs: Frederick Pearce Co., New York City. These bench legs are designed for machine shop or laboratory use. They are particularly rigid when used as center benches, away from the walls. The frame is designed to hold two shelves, the upper one for files or tools, the lower one for boxes of stock, work, etc. The leg is 2 feet 10 inches high, and 24 inches across the top. It weighs 52 pounds. The makers are prepared to furnish these bench legs in either cast iron or in a non-magnetic alloy for laboratory use, where iron would be objectionable.

Motor Driven Speed Lathe: J. G. Blount Co., Everett, Mass. This tool is intended particularly for manual training schools. The motor, which is of the constant speed type, is mounted under the leg at the head stock end of the machine, and carries a cone pulley on the armature spindle, which is belted to the spindle cone above; the spindle is carried by a head stock of a shape which permits this arrangement of belting. The spindle runs in ring oiling bearings.

High Speed Steel Cutting-Off Machine: Colton Combination Tool Co., Easthampton, Mass. This machine employs a thin abrasive wheel of carborundum, running at 2,500 revolutions per minute. This is employed for cutting steel into sections for use in tool holders. It has the special advantage of doing this with a minimum of waste, and without starting the minute fractures which are caused from nicking and breaking the bars, and which result in the cracking of the cutting edges in use.

Self-Adjusting, Friction Sensitive Drill: Barry & Zecher Co., Lancaster, Pa. This drill press provides a friction disk drive mechanism in which the pressure is constantly maintained at the proper point. The feed change and the starting and stopping of the machine are both controlled by foot levers, so that the operators hands are free. The machine is started and stopped by lowering and raising the friction disk so that no counter-shaft is necessary. The machine will be furnished with either standard or right angle drive.

Light Riveting Machine: H. B. Townsend Mfg. Co., 32 Union Pl., Hartford. Conn. In this riveting machine the rivet is struck a large number of rapid blows per minute. The head of the spindle lies in a path of a series of rolls, loosely carried on pins in the face of a rapidly rotating disk. These rolls act as hammers, in striking the riveting die on the work, as the latter is raised into contact with it by pressing a treadle on the base of the machine.

BORING JIGS USED BY THE QUEEN CITY MACHINE TOOL CO.

In the present issue of MACHINERY, Mr. Einar Morin shows several interesting designs of boring jigs in his article entitled, Jigs and Fixtures. The two accompanying illustrations, Figs. 1 and 2, are of special interest in this connection, showing as they do, two boring

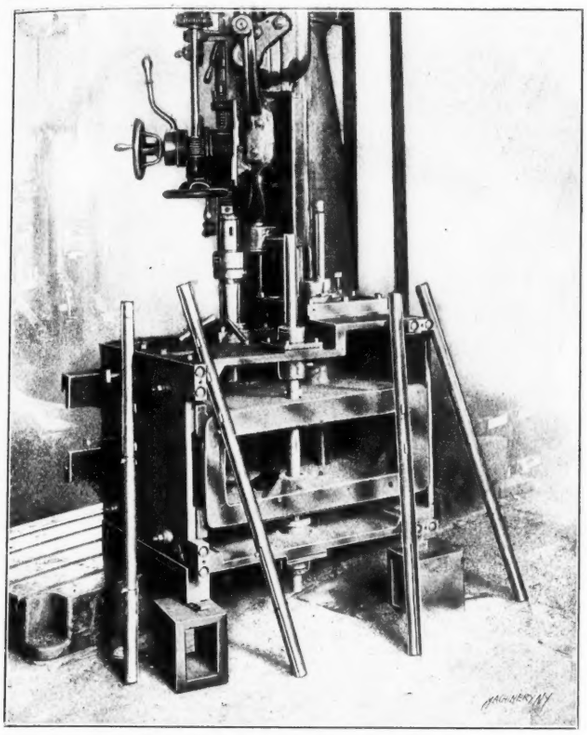


Fig. 1. Boring Jig for Shaper Columns.

jigs in operation, and illustrating the very features which have been brought out in the articles on the principles of jigs and fixtures. These two boring jigs are employed in the manufacture of shapers

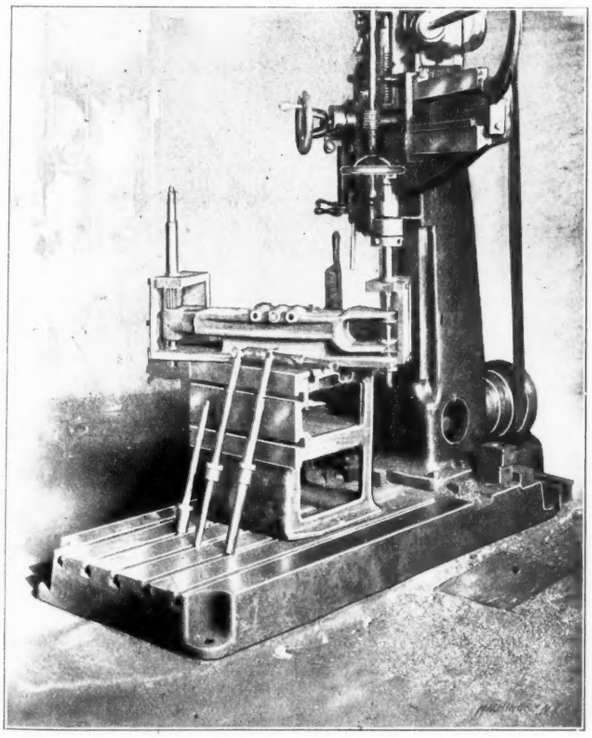


Fig. 2. Boring Jig for Boring and Reaming Holes in Rocker Arm

in the shops of the Queen City Machine Tool Co. (Station V), Cincinnati, Ohio. The illustration, Fig. 1, shows a boring jig for shaper columns. By means of this jig it is possible to get all the holes through the column in perfect alignment, and to provide for interchangeability. The jig is of the full box pattern, both ends of the boring bars being supported in the jig. The boring bars are connected with the driving spindle of the machine by universal or knuckle joints; two cuts are taken, the roughing cut leaving but a thin film of metal to be removed by the finishing cut.

In Fig. 2 is shown a boring fixture for boring and reaming the top and bottom holes in a rocker arm. These must be carefully bored at right angles to the sliding block bearing. It will be seen from the illustration that the rocker when finish planed is located on a projection of the jig, which is carefully planed at right angles to the guide holes for the boring bars. By this means it is possible to obtain bearings in the arm which are in proper relation to the sliding surface.

It is of great importance in the manufacture of these parts of the shaper, that the tools and fixtures employed fill the requirements for high-grade work, as otherwise twisting strains will be produced in the finished shaper, which are liable not only to injure the machine itself, but to cause inaccuracies in the work being performed on the machine. The influence of rigidity on the efficiency of a machine was ably demonstrated by the interesting experiments on the milling machine, undertaken by Mr. A. L. De Leeuw, and described in a paper read before the last annual meeting of the American Society of Mechanical Engineers, which paper was abstracted in the December issue of MACHINERY (engineering edition). These experiments were undertaken on a milling machine, but the necessity for rigidity, is, if anything, even greater on a shaper. There are so many joints, so much over-hang, so many parts subjected to twisting stresses that it is absolutely necessary in the machining of shapers, to use jigs and fixtures which will insure accurate work and perfect alignment, if the best results are to be obtained.

* * *

PERSONAL.

William Lonsdale, formerly assistant superintendent of the Knox Auto Co., assumed the superintendency of the same concern on January 1.

Frank S. Waters, president of the Lyon Metallic Mfg. Co., Aurora, Ill., maker of steel racks and factory equipment, has been spending a few weeks in Texas and Cuba, recuperating.

George H. Baush, sales manager of Hill, Clarke & Co., Inc., Philadelphia, Pa., has resigned his position, to take effect February 1, and will go with the Fay Machine Tool Co. of Philadelphia as general sales manager.

Augustus Brown, for the past six years superintendent of the Monarch Emery & Corundum Wheel Co., Camden, N. J., is now assistant superintendent of the American Emery Wheel Works, Providence, R. I.

Harry H. Mason, recently promoted from machine foreman to apprentice instructor in the A. T. & S. F. Ry. shops, has again been promoted to the position of bonus demonstrator, on the Middle and Oklahoma Divisions, with headquarters at Newton, Kansas.

* * *

OBITUARY.

George W. Shotwell, president of the Diehl Electrical Mfg. Co., Elizabethport, N. J., died at his home in Bayonne, N. J., January 22.

Prof. Benjamin Franklin Clarke, Professor Emeritus of mechanical engineering at Brown University, died December 29 of pneumonia at his home in Providence, R. I. Prof. Clarke was born in Newport, Me., in 1831, and since his graduation from Brown University in 1863 had been connected with the faculty. He was twice acting president of the university.

Henry Wallace Caldwell, president of H. W. Caldwell & Son Company, Chicago, Ill., died December 22 at Redlands, Cal. He was born in Kentucky in 1843. After creditable service in the civil war, he engaged in business in Indianapolis and later in St. Louis, becoming particularly interested in grain elevator management. This led to the invention of the Caldwell conveyor and the business of designing and erecting elevators. He later moved to Chicago, where he devoted his entire attention to the making of screw conveyors and other machinery for the conveying and elevating of materials and the transmission of power.

CHARLES H. BESLY.

Charles Howard Besly, head of the firm of C. H. Besly & Co. of Chicago, died at the Henrotin Memorial Hospital in that city December 31 from the effects of an operation. Mr. Besly was born in Milwaukee in 1852, educated in the Chicago public schools, and began his business experience with Marshall Field & Co. Afterwards he went with S. D. Kimbark & Co., and later with the predecessors of Crerar, Adams & Co. In 1873 he became manager of the Bergen Tool Co., Batavia, Ill., and in 1875 started in for himself as a broker in machinists' supplies. The firm of C. H. Besly & Co. was established in 1881, and comprised Mr. C. H. Besly and Mr. David J. Kennedy, being located at 175 Lake St. In 1886 Mr. Kennedy retired from the business and since that time Mr. Besly has been the sole owner. In 1891 he removed to 10–12 North Canal St., continuing there until he built the present building in 1903, at 15–21 South Clinton St.

In 1886 the Beloit factory was established in a small way for the manufacture of die-stocks, and was gradually increased for the production of various specialties, including the Besly disk grinders, "Helmet" temper taps, etc. This branch of the business grew as rapidly as the merchandise end and necessitated the erection of new and extensive buildings in 1905. Mr. Besly also owned the business of Brown & Besly, established in 1884, for the manufacture of letter files, filing cabinets, etc. This business has increased in like proportions with the others and now occupies a building of its own at 139 Besly Court, Chicago.

Mr. Besly was a graduate in chemistry of the Rush Medical College of Chicago, and also spent a year in a mechanical school in London. He was a member of many societies and clubs, including the American Geographical Society of New York, and the Engineers and Machinery Clubs of the same city; the National Machine Tool Builders' Association, and the Union League and Athletic Clubs of Chicago.

Mr. Besly was first married in 1884 to Minnie Zilpha Welles, who died in 1893, leaving one daughter. In 1894 he married Kathleen M. Healy, daughter of G. P. A. Healy, the celebrated portrait painter. Mrs. Besly, with the eldest daughter and three younger daughters survive him.

Mr. Besly was widely known among Chicago business men and to the machinery trade all over the country. While he was a shrewd and successful business man, he gave liberally and unostentatiously where his sympathies were enlisted, and when he thought his help would be of practical benefit. He was an unusually well-read man, and his keen observation enabled him to present his knowledge in an attractive way which is not often found with men who so closely apply themselves to business. These traits and his jovial disposition made him many warm friends to whom his death was a heavy loss.

Mr. Besly's large interests were left in a strong financial and physical condition, and will be continued as heretofore under the general management of Mr. Edward P. Welles, his nephew, who has been connected with the firm of C. H. Besly & Co. for the past twenty-two years, and as general manager since 1896.

* * *

Next to gold, silver is the most malleable and ductile metal. It may be hammered into foil 0.0001 inch in thickness, and a single grain can be drawn into wire over 400 feet long.—*Brass World.*

HILL, CLARKE & CO.'S "FAMILY PARTY."

The "family party" given annually by Hill, Clarke & Co. of Chicago to the manufacturers they represent and to their organization in the West, took place on January 11th at De Jonghe's restaurant in Chicago. There was everything one could think of to eat and drink, speechifying and music—and no casualties. Those present were: Mr. Bosch of the Western Tool Works, Holland, Mich.; Mr. J. N. LaPointe of the LaPointe Machine Tool Co., Hudson, Mass.; Mr. Ralph LaPointe of the Universal Boring Machine Co., Hudson, Mass.; Mr. Wood of the Wood Turret Machine Co., Terre Haute, Ind.; Messrs. Adt and Case of the Geometric Tool Co., New Haven, Conn.; Mr. H. E. Flather of Flather & Co. and Mr. E. J. Flather of the E. J. Flather Mfg. Co., Nashua, N. H.; Messrs. Kearney and Trecker of the Kearney & Trecker Co., Milwaukee, Wis.; Mr. August Marx of the Gray Planer Co., Cincinnati, Ohio; Messrs. Sibley and Workinger of the Sibley Machine Tool Co., South Bend, Ind.; Mr. Thwing of the Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.; Mr. Van Hyning of the Bignall & Keeler Mfg. Co., Edwardsville, Ill.; Mr. Carlton of the Consolidated Press & Tool Co., Hastings, Mich.; Mr. O'Brien of the South Bend Machine Tool Co., South Bend, Ind.; Messrs. Clarke, Wigglesworth, Mons, Ditfurth, Hale, Wendland, Kimball and Brandes of Hill, Clarke & Co., of Chicago, and Mr. Luchars of MACHINERY.

* * *

COMING EVENTS.

February 1-6—Second Annual Hartford Industrial Show of machinery, tools, accessories, supplies, etc., will be held in Foot Guard Hall, Hartford, Conn. R. B. Jacobs, general manager, Hartford, Conn.

February 9.—First regular meeting of the National Gas and Gasoline Machine Trades Association at the Auditorium Hotel, Chicago, Ill.

March 27-April 3.—Mechanical and Electrical Exhibition, under the auspices of the Worcester County Mechanics Association, in Mechanics Hall, Worcester Mass. The exhibition will include machinery in operation, manufacturing goods, and is under the direction of Mr. H. F. Campbell, superintendent, room 6, Mechanics Hall, Worcester.

May 18-20. American Foundrymens' Association convention. Cincinnati, Ohio, Hotel Sinton, headquarters. Richard Moldenke, sec'y, Watchung, N. J.

June 16-18.—Annual convention of Railway Master Mechanics Association on Young's Million Dollar Pier, Atlantic City, N. J. Joseph W. Taylor, Old Colony Building, Chicago, Ill., secretary.

June 16-23.—An exhibition of machinery, tools and supplies for the railway supply trade will be held under the auspices of the Railway Supply Manufacturers Association. Membership dues in the association are $25.00 per year and carry one badge only. Additional badges may be obtained by members for $5.00 per badge. Contracts have been let for the erection of exhibition structures covering 59,000 square feet, exclusive of aisles. The charge to exhibitors will be 40 cents per square foot, to cover the cost of erection, etc. The association has prohibited the distribution of souvenirs. Application for space should be made immediately to Mr. Earl G. F. Smith, secretary, 345 Old Colony Building, Chicago, Ill.

June 21-23.—Annual convention of the Master Car Builders Association on Young's Million Dollar Pier, Atlantic City, N. J. Joseph W. Taylor, Old Colony Building, Chicago, Ill., secretary.

NEW BOOKS AND PAMPHLETS.

COMPARATIVE TESTS OF RUN-OF-MINE AND BRIQUETTED COAL ON LOCOMOTIVES. By W. F. M. Goss. 57 pages, 6 x 9 inches. Published by the Department of Interior, United States Geological Survey, Washington, D. C., as Bulletin No. 363.

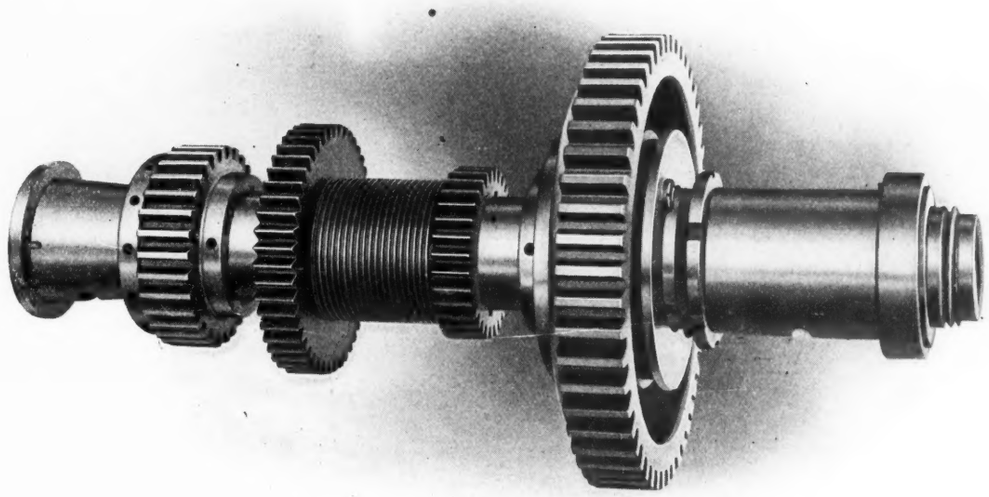
The report includes torpedo boat tests and some foreign specifications for briquetted fuel. The locomotive testing plant of the Pennsylvania R.R. at Altoona, Pa., was the scene of the locomotive tests made by Professor Goss; and the pamphlet is illustrated with halftone and line drawings showing the characteristic features of the plant. The results of the test will be studied with much interest by those interested in the fuel problem.

HANDBOOK OF SMALL TOOLS. By Erik Oberg. 526 pages, 5½ x 8 inches, 282 illustrations. Published by John Wiley & Sons, New York. Price $3.00.

The advent of this work on threading tools, taps, dies, cutters, drills, reamers, counterbores, hollow mills and other accessories of the machine shop and metal-working trades emphasizes the specialization which marks American mechanical development, and the genius for classification that has made that development possible. The old-school mechanical engineer considered the details of small tools a matter scarcely worthy of his distinguished consideration, being something that could safely be left to the whims, vagaries, ideas—good, bad and indifferent—of the machinist, toolmaker and other mechanics using them. But the same human faculty that enables the scientist to classify all animal life, from bugs to elephants, placing each representative of type in its respective class, can be profitably employed to organize and classify every detail of manufacture. Nothing is too small or insignificant to be overlooked. The surprising fact is learned in such work, that the small things are the real factors that make for success or failure. The importance of small tools in the mechanical trades is expressed by a word—indispensable; the efficiency of production depends as much on them as on the machines and men. The author has treated his subject principally from the manufacturing point of view, giving the details of standard manufacturing practice in the matter of pitch, lead, diameter, angles, rake, clearance, numbers of teeth, shape of flutes, sizes of squares, dimensions of shanks, taper per foot, and the thousand-and-one other details that are important in the manufacture of small tools. The book contains 134 tables of valuable data, most of which are for the first time published herein, or were originally published by the author in MACHINERY. The formulas for obtaining the dimensions of tools are largely of the author's own derivation. The following table of contents will give an idea of the scope and value of the work to manufacturers, tool-makers and others concerned with the making and maintenance of small tool equipment: Screw-thread systems; methods and principles of thread-cutting; measuring threads; threading tools; definitions of taps; hand taps; tapper taps and machine taps; screw machine taps; hobs and die taps; taper taps; miscellaneous taps; threading dies; plain and side milling cutters; miscellaneous milling cutters; reamers; drills; counterbores; hollow mills; lathe arbors. **The work is not a treatise on tool-making practice, but rather a collection of data, elaborated and fully explained. It tells *what to do* rather than *how to do it.***

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U. S. A.



THE SPINDLE

A Vital Part in the B. & S. Constant Speed Drive Milling Machine

It is Massive, Strong and Amply Proportioned, Capable of Transmitting all the Power the Belt will Deliver without being Affected by the Bending and Twisting Strains to which a Spindle of this Nature is Necessarily Subjected.

IT IS MADE FROM HAMMERED, CRUCIBLE STEEL—a strong, close grained steel, which affords smooth running and excellent wearing qualities.

THE BOXES are solid, heavy and long, made from a special bearing bronze that has been found best adapted to heavy service.

AN EFFICIENT METHOD FOR LUBRICATION is furnished by means of large reservoirs cast in the frame of the machine.

EASY MEANS FOR TAKING UP WEAR are provided; wear of either bearing can be compensated for without disturbing the adjustment of the other.

RECESS IN END gives greater strength for heavy cuts than slot across.

ALL GEARS of exceptionally large diameter, wide face and coarse pitch in comparison to their duty.

An important feature—

All Speed Changing Gears of Hardened Steel. The Value of this Feature no Authority will Dispute.

STUDY THE CUT

CATALOGUES AND CIRCULARS.

HESS-BRIGHT MFG. CO., Philadelphia, Pa. Vest pocket celluloid novelty in the shape of a ten-year calendar, advertising the Hess-Bright ball bearings.

BURKE MACHINERY CO., 1837 35th St., Cleveland, Ohio. Catalogue of bench and column milling machines, index centers, drill press vises, sensitive drill presses, tapping machines, oil forges, pattern-makers' saws, etc.

TATE, JONES & CO., INC., Pittsburg, Pa. Pamphlet entitled "Oil vs. Coal," being illustrated with views showing the oil furnaces built by the company which are now in use in manufacturing plants.

CLEVELAND PUNCH & SHEAR WORKS, Cleveland, Ohio. Stock list of machine and small tools for the fabrication of iron and steel. The company makes a specialty of punches, and punching and shearing machines.

FOOTE-BURT CO., Cleveland, Ohio. A leaflet showing illustrations and specifications of the No. 24 high duty drill, 24-inch swing, which was illustrated and described in the January number of MACHINERY.

CARTER & HAKES MACHINE CO., Winsted, Conn. Catalogue of Lincoln milling machines, hand milling machines, screw and lever vises. The company has improved its Lincoln type miller with an automatic quick return. The company builds special machines to order.

CRESCENT TOOL CO., Jamestown, N. Y. Catalogue illustrating and describing the "Crescent" adjustable wrench, "Crescent" combination pliers, "Crescent" lineman's pliers, etc. The "Crescent" adjustable wrench was illustrated in the January number of MACHINERY.

ECK DYNAMO & MOTOR CO., Belleville, N. J. Bulletin No. 40, illustrating and describing Eck protected and inclosed types of direct-current motors. An interesting feature of the bulletins is that one or more pages in each is given up to data to aid in the selection and installation of electrical apparatus.

BEAUDRY & CO., INC., 141 Milk St., Boston, Mass. Catalogue of the "Champion" power hammer which is built in sizes from 50 to 500 pounds weight of ram, and adapted to almost all kinds of forging, from knife blades to welding a 6-inch shaft of iron.

NORTHERN ENGINEERING WORKS, Detroit, Mich. Small catalogue of foundry equipment and machinery, listing the Newten cupola, the Keep sectional cupola, foundry elevators, electric hoists, traveling cranes, drills, trucks, turntables, tumbling barrels, etc.

NEW DEPARTURE MFG. CO., Bristol, Conn. Catalogue of the "New Departure" two-in-one ball bearings made for general uses. The catalogue illustrates the use of these bearings on automobile crank shafts, automobile transmission gear box bearings, etc.

GOLDSCHMIDT, THERMIT CO., 90 West St., New York. Pamphlet entitled "Thermit Repairs," illustrating repairs and welds made by "Thermit" process on street railway motor cases, truck frames, rails, locomotive cylinders, locomotive wheel centers, anchors, connecting-rods, turbine water wheels, crankshafts, gear wheels, fly-wheels, etc.

FERRACUTE MACHINE CO., Bridgeton, N. J. Catalogue of power presse for punching, forming, drawing, re-drawing, etc. The line includes a great variety of styles, and ranges from small presses to presses having capacity and power to draw up a metal burial casket. The company also builds board drop-hammers, punching presses, and spinning lathes.

INTERNATIONAL ENGINEERING CO. OF NEW JERSEY, 1779 Broadway, New York City. Catalogue illustrating RBF radial and thrust ball bearings manufactured by the Societe Francaise Des Roulements A Billes. The radial bearings are assembled without nicks or slots in the rings or filling pieces, no auxiliary parts whatever being required.

THOMAS H. DALLETT CO., 23d and York Sts., Philadelphia, Pa. Catalogue No. 10 of steam- and belt-driven air compressors. The line of compressors listed and described is new, having features of novelty and improvement. Both steam- and belt-driven machines are built single, duplex and compound with air cylinder dimensions ranging from 8 x 8 inches to 12 x 18 inches.

J. T. SLOCOMB CO., Providence, R. I. Catalogue and price list of machinists' tools, including inside, outside and micrometer calipers, standard screw thread micrometers, tube micrometers, quick-acting micrometers, outside micrometers in sets from 0 to 24 inches, standard reference disks, standard end measures, combined centering drills, etc.

CORBETT SUPPLY CO., Trenton, N. J. Catalogue of general mill supplies containing 519 pages, 6 x 9 inches. The supplies listed include pipe fittings, valves, boilers, gage testers, injectors, pumps, blacksmiths' tools, machinists' tools, pipe cutters, files, carpenters' tools, bolts, nuts and screws, linemen's tools, boiler-makers' tools, belt-lacing machines, etc.

GRANT NAIL & SUPPLY CO., 47 High St., 23 Purchase St., Boston, Mass. Catalogue of Turney adjustable high-speed lathe and machine reamers and Turney floating reamer holder. These reamers are of novel construction being simple, easily adjusted and solid when set. They have been in general use in one of the best known manufacturing plants of this country for some time, giving good satisfaction.

HOEFER MFG. CO., Freeport, Ill. Catalogue of drill presses, power metal saws, horizontal boring machines and vertical boring machines. The line of drill presses includes a model, having a long arm, the spindle being either belt or friction disk driven. This line is for very light drilling and is designated as assembling drills. The company are specialists on wire forming machines, and lists two-slide and four-slide forming machines in the catalogue.

COLUMBUS PNEUMATIC TOOL CO., Columbus, Ohio. Leaflet illustrating the Dunlap file sharpener. The machine sharpens worn files rapidly, using steam, at a pressure of 100 pounds or more, supplied by two nozzles, operating on opposite sides of the file. An inexpensive abrasive is impinged by the steam against the worn file, restoring the teeth to approximately the same shape as when new.

NATIONAL ACME MFG. CO., Cleveland, Ohio. Catalogue of Acme automatic multiple-spindle screw machines, and Acme automatic screw slotting machines. The catalogue illustrates the action of the multiple-spindle automatic in detail in an interesting manner. The catalogue is profusely illustrated throughout and beautifully printed, being one of the handsomest catalogues published by a machine tool concern. A large number of parts made on the automatic are illustrated in colors appropriate to the character of the metal used, the steel parts being in steel gray, and the brass parts being in a shade of orange.

NATIONAL TUBE CO., Frick Building, Pittsburg, Pa. Pamphlet entitled "Shelby Steel Tubes and Their Making," being, we believe, the most complete description of making seamless steel tubing that has been published. The pamphlet is a beautiful example of the printer's and engraver's art, being well printed on coated paper and illustrated with numerous halftones, showing the processes of centering, piercing, sawing and drawing plates into tubes. Many other phases of the manufacture of steel tubes are illustrated and altogether it is one of the finest examples of valuable technical literature issued by a manufacturer in the interest of his business, that we have seen.

MANUFACTURERS NOTES.

PROVIDENCE BRASS & ALUMINUM CO., Providence, R. I., has taken over the business of the Providence Aluminum Co. There will be no change in the management.

WILLIAM S. NICHOLLS, 254 Broadway, New York, has taken over the manufacture and sale of the "Economy" emery frame or grinder formerly made by George E. Soper, Kankakee, Ill.

CLARK HINES, formerly superintendent in the Wolverine Motor Works, Bridgeport, Conn., has built a machine and repair shop, 30 feet x 50 feet, on Connecticut Ave., Bridgeport, Conn., for automobile repairing.

GISHOLT MACHINE CO., Madison, Wis., has opened display rooms at Washington Boulevard and Desplaines St., Chicago, Ill., where a line of Gisholt labor-saving machines and tools have been installed for demonstration purposes.

GOULD & EBERHARDT, Newark, N. J., announce that on and after February 1st they will be represented in Philadelphia and surrounding territory by the W. E. Shipley Co., The Bourse, Philadelphia, instead of the Fairbanks Co. of Philadelphia, as formerly.

REYNOLDS MACHINE CO. has removed from Rock Island, Ill., to Moline, Ill., where, in addition to its present line of power screw driving machines, it will manufacture the simple hobbing spur gear cutter, described in the August, 1908, issue of MACHINERY.

NORTHERN ELECTRICAL MFG. CO., Madison, Wis., has removed its St. Paul district office to 1046 Security Bank Building, Minneapolis, Minn. The new office is larger than the old office and the facilities for taking care of the customers in the "Twin Cities" have been greatly improved. Mr. T. E. Drohan, formerly superintendent of the Northern Works, is in charge.

LAKE TORPEDO BOAT CO., Bridgeport, Conn., has bought a plot of land at the foot of Sea View Ave., on which a machine shop, 25 feet x 105 feet two stories high, will be built. An office building will also be constructed alongside of the machine shop, two stories high. The office building will have a saw-tooth roof, and the entire upper floor is to be used for a drafting room.

PORTER-CABLE MACHINE CO., Syracuse, N. Y., has begun the manufacture of a sensitive, high-speed, universal milling attachment, that can be used on any standard milling machine. With the pulleys regularly furnished with the attachment, almost any speed up to 2500 revolutions per minute can be obtained, and still higher speeds are made possible by providing special pulleys of large diameter.

NORTHERN ELECTRICAL MFG. CO., Madison, Wis., exhibited at the National Corn Show, Omaha, Neb., early in December, a 1½ K.W. electric generator driven by a 3 H.P. Alamo engine, built by the Alamo Mfg. Co., Hillside, Mich. This direct-connected set was finished in white enamel, and attracted much attention. It is believed that the exhibit did considerable in pushing the use of electricity into homes and farm service.

THE UNITED STATES BRAKE SHOE CO., Corry, Pa., has been organized with a capital of $100,000, and a concrete and steel foundry building will be erected. The officers are: Louis Steruber, president; J. F. Austin, secretary and treasurer, and J. J. Ressler, general manager. The concern is the successor of the old Eagle Iron Works, which will be enlarged by the addition of the new building.

AMERICAN BLOWER CO., Detroit, Mich., and the Sirocco Engineering Co., Troy, N. Y., have consolidated and both plants will be operated under the name of the American Blower Co., the headquarters of the corporation being in Detroit. The capitalization of the American Blower Co. has been increased from $500,000 to $1,500,000, and the company has been incorporated under New York State laws.

W. S. NICHOLLS, 254 Broadway, New York City, manufacturer of the "Hercules" portable crane hoist, reports a growing demand for this all-steel portable crane. Orders have been received recently from prominent machine tool concerns and other manufacturers, among which are the American Steel & Iron Co., Gisholt Machine Co., National-Acme Mfg. Co., Hendey Machine Co., Tennessee Coal, Iron & Ry. Co., Westinghouse Machine Co., Union Switch & Signal Co., etc.

TINIUS OLSEN & CO., 500 North 12th St., Philadelphia, Pa. The Herbert File Testing Machine, described in the December, 1907, issue of MACHINERY is now sold by this firm, who have been appointed sole distributors in the United States They are using one machine themselves night and day, and expect to add a second machine soon. In this work of file testing they have found that the two sides of many files vary in efficiency to an unbelievable extent. Some files are found to be twenty times better than others. They are prepared to do testing for customers as well as to sell the machines.

W. H. SMEAD, formerly mechanical engineer for the General Fire Extinguisher Co., southern department, late mechanical engineer for the Proximity Mfg. Co., Greensboro, N. C., has opened an engineering office in the McAdoo Building, Greensboro, N. C. Mr. Smead will do a general engineering business, making a specialty of designing steam power plants, heating and fire protection systems. He is a member of the Engineering Association of the South and a junior member of the American Society of Mechanical Engineers, and has fourteen years' experience in the engineering business.

MCMULLEN MACHINERY CO., Grand Rapids, Mich., has been incorporated with a capital of $15,000 for the purpose of establishing a wood-working machinery depot at 585 South Ionia St., Grand Rapids, where a stock of wood-working machinery for all purposes will be carried. The president, Mr. George K. McMullen, was for ten years sales manager of the Fox Machine Co. of Grand Rapids and is well known in the territory in which his company will push their business, that is principally in western and northern Michigan. Manufacturers of wood-working equipment desiring to be represented in the Middle West are requested to communicate with the new company.

TINIUS OLSEN & CO., 500 North 12th St., Philadelphia, Pa., have been appointed sole selling agents for the White-Souther endurance testing machine. This machine is of the rotary type, the test piece being mounted on a hollow revolving spindle with the loads applied at the outside ends. The device is rapidly rotated and revolving counters record the number of vibrations the specimen was subjected to when it failed. The machine tests both ends of the specimen and gives separate records for each end, the counters automatically stopping when the specimen breaks. All revolving parts are mounted in ball bearings, thus reducing the torsional resistance to a minimum.

ROCKWELL FURNACE CO., 26 Cortlandt St., New York, has been awarded the contract covering the complete furnace equipment for the new locomotive shops of the D. L. & W. R.R., at Scranton, Pa. The furnace equipment consists of thirty-five of the latest type furnaces operated with 300 B. T. U. water gas, which is made in Loomis Pettibone producers. These shops will be capable of turning out complete locomotives, and are to be in operation in three months. No pains or expense has been spared to make them up to date, as they embody the latest and most improved machinery and equipment, selected after thoroughly inspecting a large number of modern railway and industrial plants throughout the country.

CARBORUNDUM CO., Niagara Falls, N. Y., has increased its already extensive plant with the addition of a four-story brick and steel structure, 60 feet wide and 225 feet long. One entire floor is to be given over to the manufacture of carborundum sharpening tools, hones, scythe stones and other sharpening specialties. The other floors will be used for wheel molding taps and storage. Several new lines have been added to its manufacturing productions during the past year. These include garnet paper and cloth, used largely in the wood and furniture trade, and emery paper and cloth, used in finishing metal and machinery parts. The company has plans under way for covering the entire abrasive field with its products.

INDEPENDENT PNEUMATIC TOOL CO., Chicago, Ill. At the last annual meeting of the directors, which was held in Chicago, the following officers were elected: James B. Brady, president; W. O. Jacquette, 1st vice-president; John D. Hurley, 2d vice-president, and A. B. Holms, secretary and treasurer. The annual report shows that the company is in good financial condition and during the quarter ending December 31, 1908, 40 per cent more business was transacted than during the same period of 1907. The company has sufficient business in "Thor" piston air drills, tapping and wood boring machines; pneumatic riveting, chipping, calking and beating hammers, etc., to keep its Aurora, Ill., plant running for several months at its fullest capacity.

MACHINERY CLUB, 50 Church St., New York, entertained its members and their friends with a club smoker and vaudeville on the afternoon of January 16th. Church warden clay pipes and clay pipe button-hole souvenirs were distributed, together with the necessary "ammunition" for making smoke. The program included Billy Carter, banjo specialist; Neapolitan Troubadours; "Prof." Waters, magician; and other noted vaudeville artists. Mr. Homer Davenport gave one of his inimitable illustrated talks, the sketches being made "while you wait." The Machinery Club, which was opened May 21, 1908, has grown to a membership of over 1,100. The organization and larger membership reflects much credit on Mr. F. H. Stillman, president, and the other officials active in its organization and conduct.

WESTINGHOUSE MACHINE CO. reports that Cia Azucarera del Panuco, Tampico, Mexico, has placed an order with it for a complete producer gas-electric power plant. This initial installation will consist of a vertical, three-cylinder, single-acting engine and a 150 H.P. suction producer, designed to operate on

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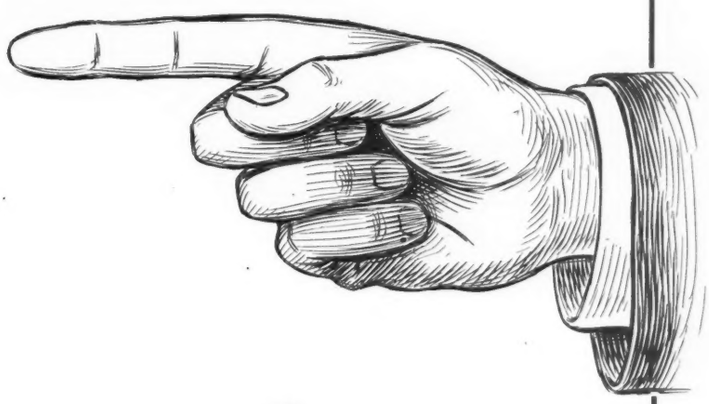

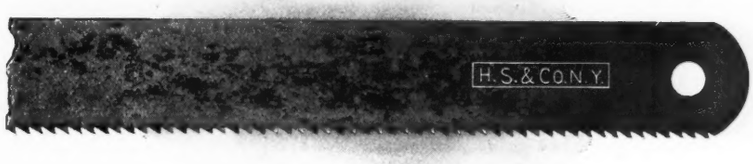

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small anthracite coal. The use of the suction producer in such large sizes has proven thoroughly practicable, and considerable business is anticipated along this line. Even larger sizes of producers of the suction type are contemplated by the builders. The New York Standard Watch Co., Jersey City, N. J., also operates a suction producer gas plant of considerable size, and recently added another unit to their plant. A number of contracts have been let for gas engines operating temporarily on natural, or illuminating gas, with the intention of later changing over to producer-gas operation. A 200 H.P. plant has been ordered by Seaver & Co., Chelsea, Mass., and by the Cambridge Gas Co., Cambridge, Md. The Shelbourne Falls (Mass.) Electric Light Co. have adopted the power gas system and have ordered a 175 H.P. Westinghouse suction producer for anthracite coal.

AMERICAN LOCOMOTIVE CO., 30 Church St., New York, has purchased a plot of 130 acres of land at Gary, Ind., from the Gary Land Co., a subsidiary company of the United States Steel Corporation, and plans are being drawn for a new plant which officers of the locomotive company say will be the most complete and best equipped locomotive works in the world. The land purchased is twice the extent of that occupied by the largest of its present plants and when fully occupied will give employment to from 12,000 to 15,000 workmen. The land adjoins that of the new plant of the United States Steel Corporation. This site was selected at Gary, twenty-four miles from Chicago, to provide for the territory where the largest number of railroads converge to a single commercial center. The Chicago district is a great railroad center and that district is rapidly developing in manufacturing importance, which renders it favorable as a location for securing material for building locomotives. This company now operates plants in Schenectady and Dunkirk, N. Y.; Pittsburg and Scranton, Pa.; Richmond, Va.; Paterson, N. J.; Manchester, N. H.; and Montreal, Canada. At present there is no large locomotive plant west of Pittsburg, and the selection of a location in the Chicago district provides additional locomotive building capacity where it is most needed for prompt and direct delivery to a large number of railroads. The size of the new plant will be sufficient to provide liberally for the growing needs of the railroads for years to come.

MISCELLANEOUS.

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